

4 March 2002 Staff Workshop

Total Maximum Daily Loads
for the San Joaquin River:
Organophosphorus Pesticides
& Salt and Boron



CVRWQCB

San Joaquin River TMDL Unit

Workshop Agenda

- Morning Session:
Organophosphorus Pesticide TMDL
 - Welcome and Introductions
 - Overview of Regional Board's TMDL Development Process and Timelines
 - Organophosphorus Pesticide TMDL
 - Staff presentation
 - Questions and discussion
- Afternoon Session: Salt and Boron TMDL

What Is a TMDL and Why Do One?

- TMDL = Total Maximum Daily Load
- TMDLs are required under section 303(d) of the Federal Clean Water Act
 - TMDLs must be developed for pollutants and waterbodies that have been identified on 303(d) list of impaired waterbodies

What Is a TMDL?

- A total maximum daily load (TMDL) is the amount of a specific pollutant that a waterbody can receive and still maintain a water quality standard
- TMDLs allocate pollutant loads to point and nonpoint sources...

What Is a TMDL?

- $\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS} + \text{background}$

WLA: waste load allocation for point sources

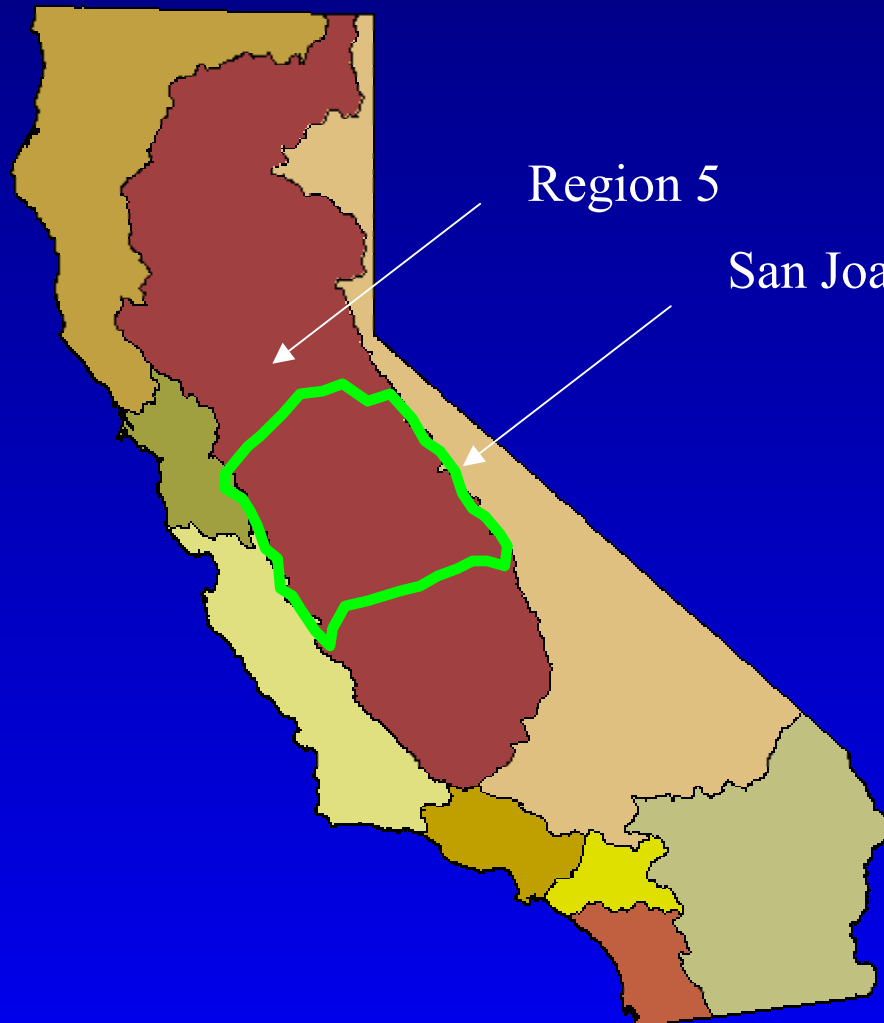
LA: load allocations for nonpoint sources

MOS: margin of safety

Components of TMDLs

- TMDL Description (Problem Statement)
- Numeric Targets (will often be new water quality objectives)
- Source Analysis
- Allocations
- Linkage Analysis (relationship between sources, allocations, and targets)
- TMDL Report
- *Implementation Plan*

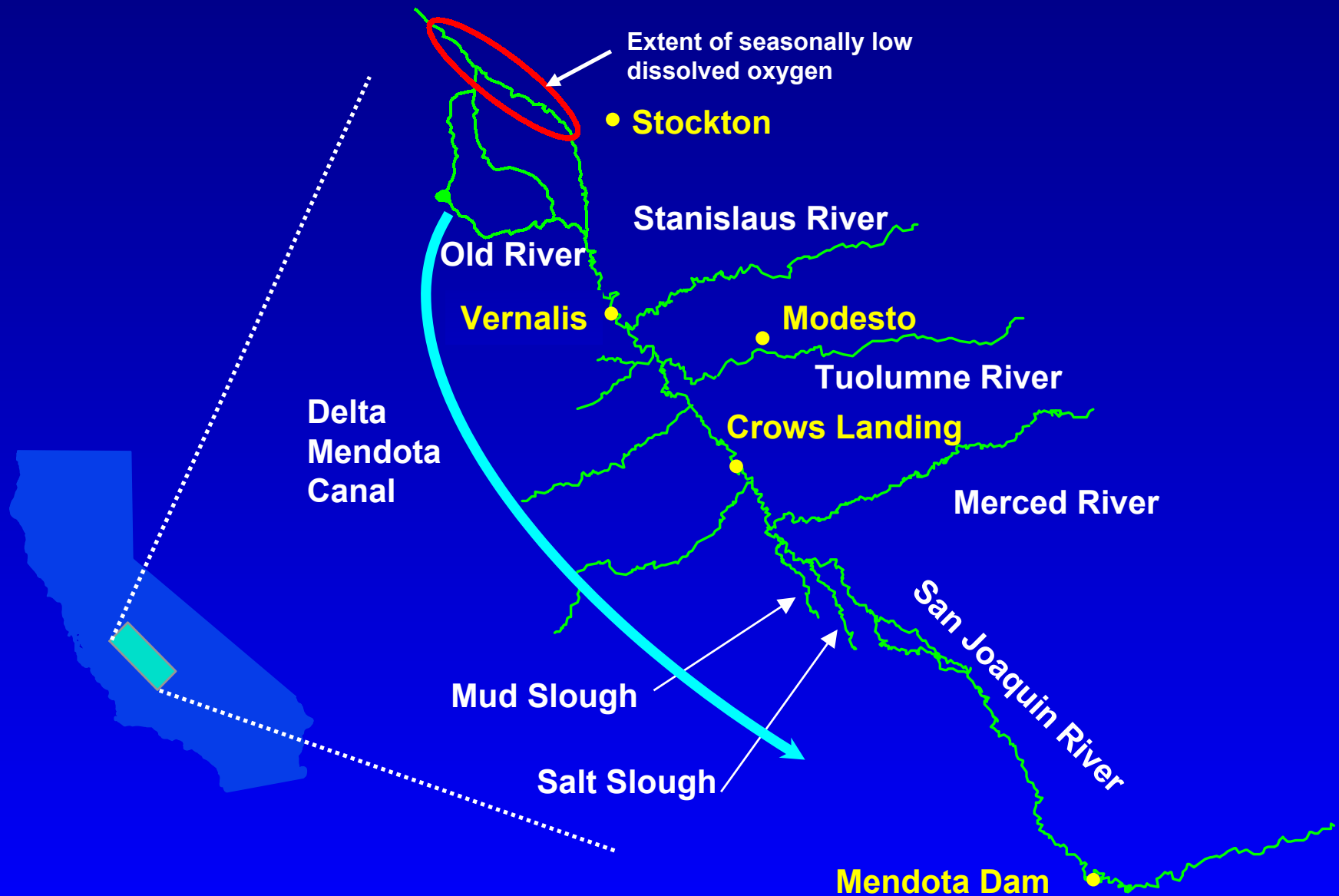




Region 5

San Joaquin River Basin

Lower San Joaquin River Basin



TMDL Timeline

Current Activities

Watershed	June 2001	June 2002	June 2003
San Joaquin River	Selenium Salt & boron	Diazinon & chlorpyrifos	
Delta			Dissolved oxygen Diazinon & chlorpyrifos Mercury
Sacramento River	Copper, zinc, & cadmium	Diazinon	
Clear Lake	Mercury		
Cache Creek		Mercury	

San Joaquin River TMDLs

Actual Completion Dates

- Selenium TMDL: August 2001
- Salt and Boron TMDL : January 2002
- Organophosphorus TMDL: on time



San Joaquin River Organophosphorus (OP) Pesticides TMDL Workshop

Source Analysis

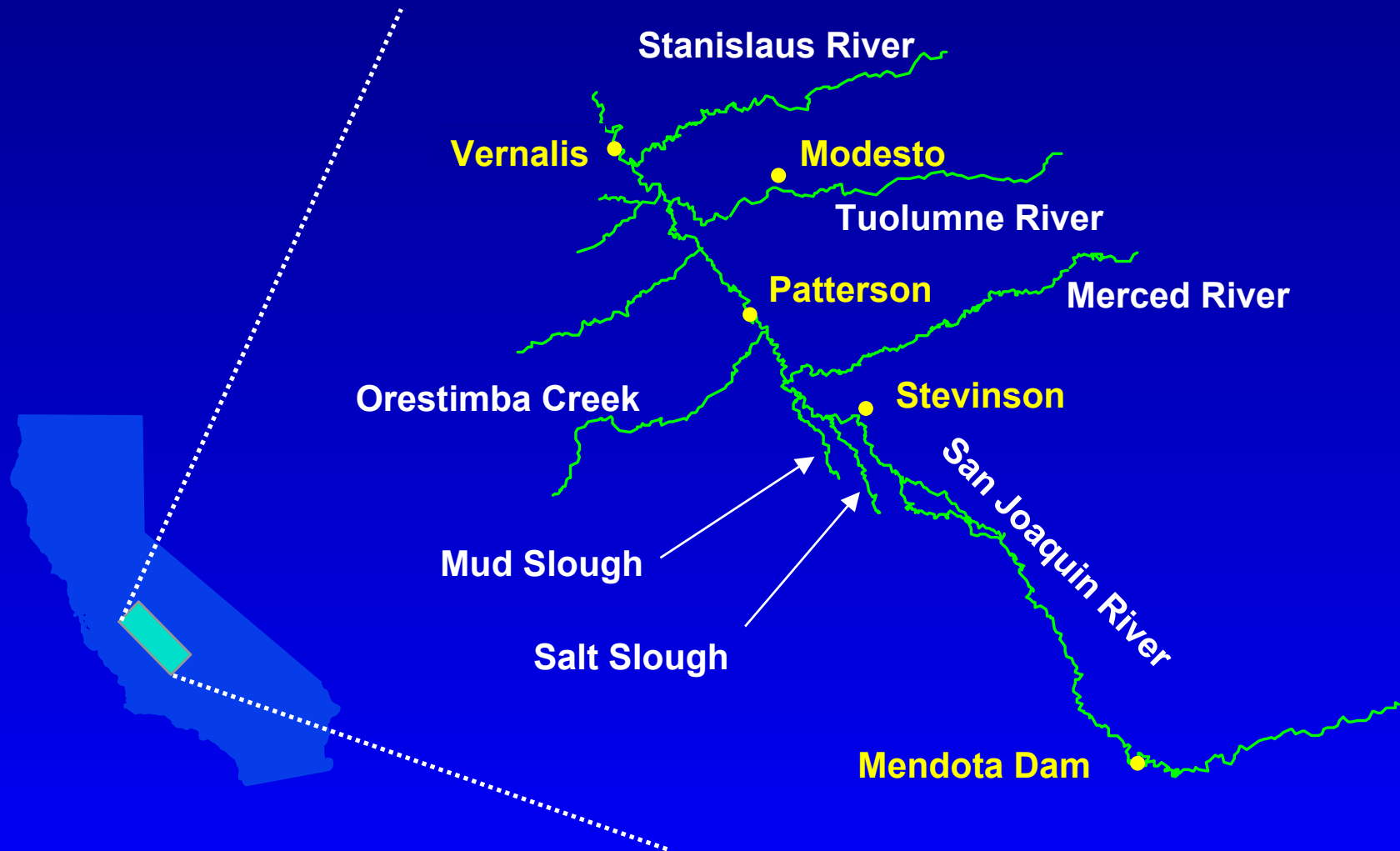


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Emilie Reyes
Matthew McCarthy
Daniel Leva
San Joaquin River TMDL Unit

Topics to be Covered

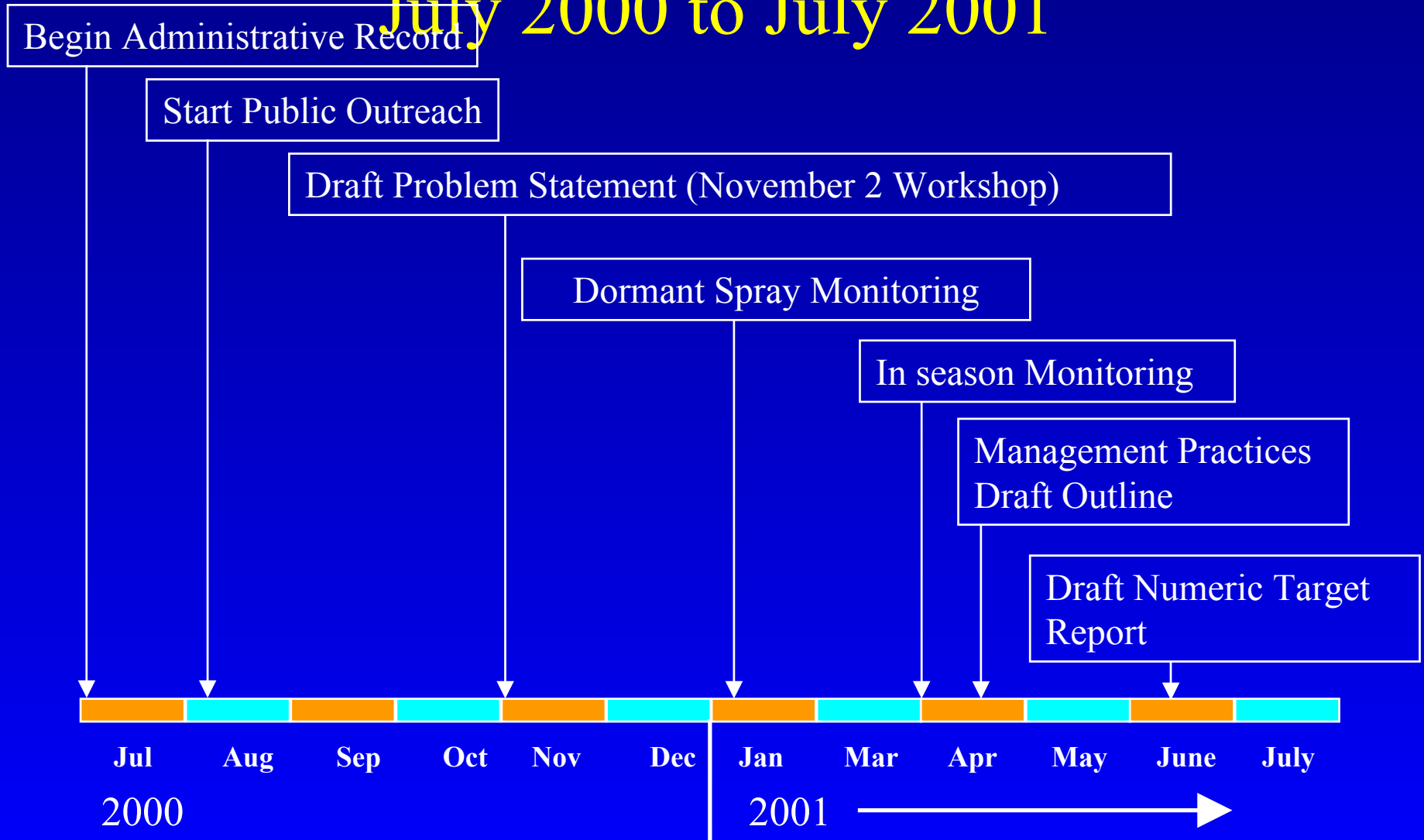
- TMDL Components & Timeline
- Background Information
- Source Analysis
 - Pesticide Application
 - Mass Loading
 - Sources of OP Pesticide
- Next Steps

Project Area for OP Pesticides TMDL



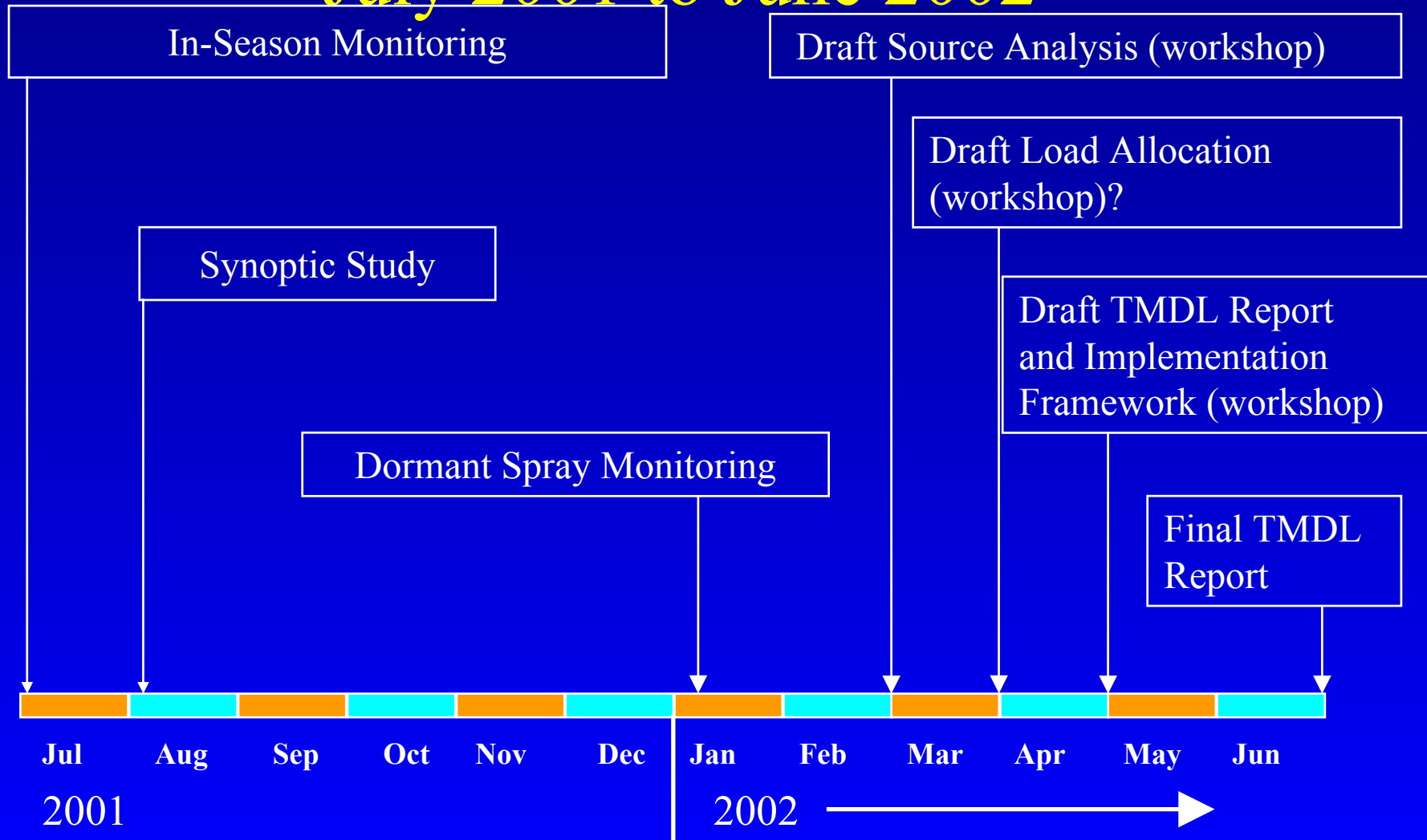
SJR OP Pesticide TMDL Timeline

July 2000 to July 2001



SJR OP Pesticide TMDL Timeline

July 2001 to June 2002



Components of TMDL

- TMDL Description (Problem Statement)
- Numeric Target
- Source Analysis
- Load Allocation
- Linkage Analysis
- TMDL REPORT
- *Implementation Plan*

Components of TMDL

- TMDL Description (Problem Statement)
- Numeric Target

Completed and available on web:

<http://www.swrcb.ca.gov/rwqcb5/programs/tmdl/index.htm>

Components of TMDL

- TMDL Description (Problem Statement)
- Numeric Target
- **Source Analysis**
- Load Allocation
- Linkage Analysis
- TMDL REPORT
- *Implementation Plan*

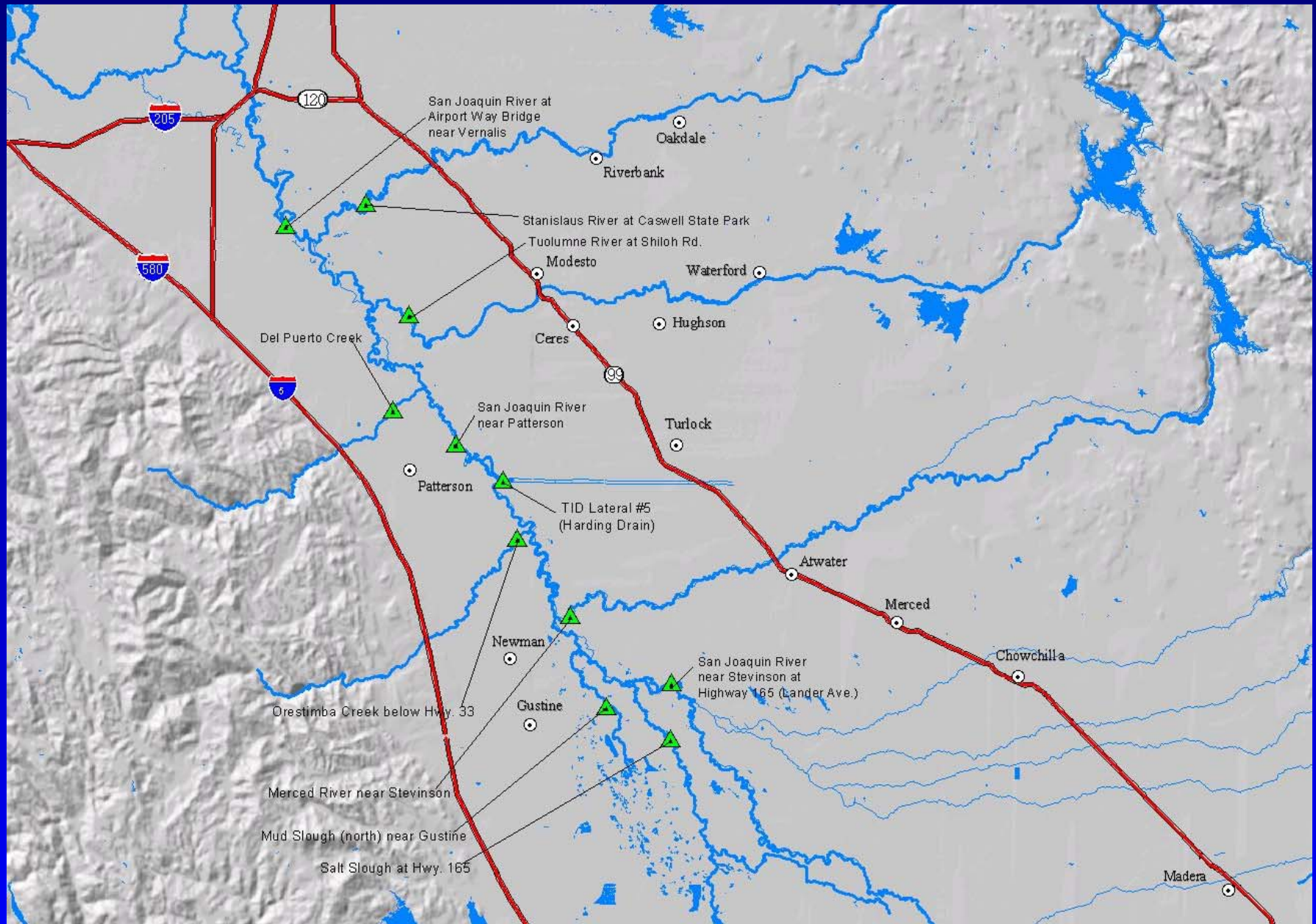
Results of Target Analysis: Recommended Targets U.S.EPA Method as used by CDFG

Diazinon (ng/L)		Chlorpyrifos (ng/L)	
Acute	Chronic	Acute	Chronic
80	50	25	14

Note 80 ng/L = 0.08 ug/L

Background Information

- Where we are?
 - SJR near Vernalis (10 years – 1991 to 2001):
 - Diazinon acute criteria exceeded 85 times
 - Chlorpyrifos acute criteria exceeded 11 times
- Where do we need to be?
 - EPA guidance for calculating design flows to protect aquatic life: acute water quality objective should not be exceeded more than once every three years



Number of Sampling Days

250
200
150
100
50
0

2000
1997
1994
1991

SJR @ VERNALIS
stanislaus river
tuolumne river
del puerto creek
SJR @ PATTERSON
orestimba creek
merced river
mud slough
salt slough
SJR @ STEVINSON

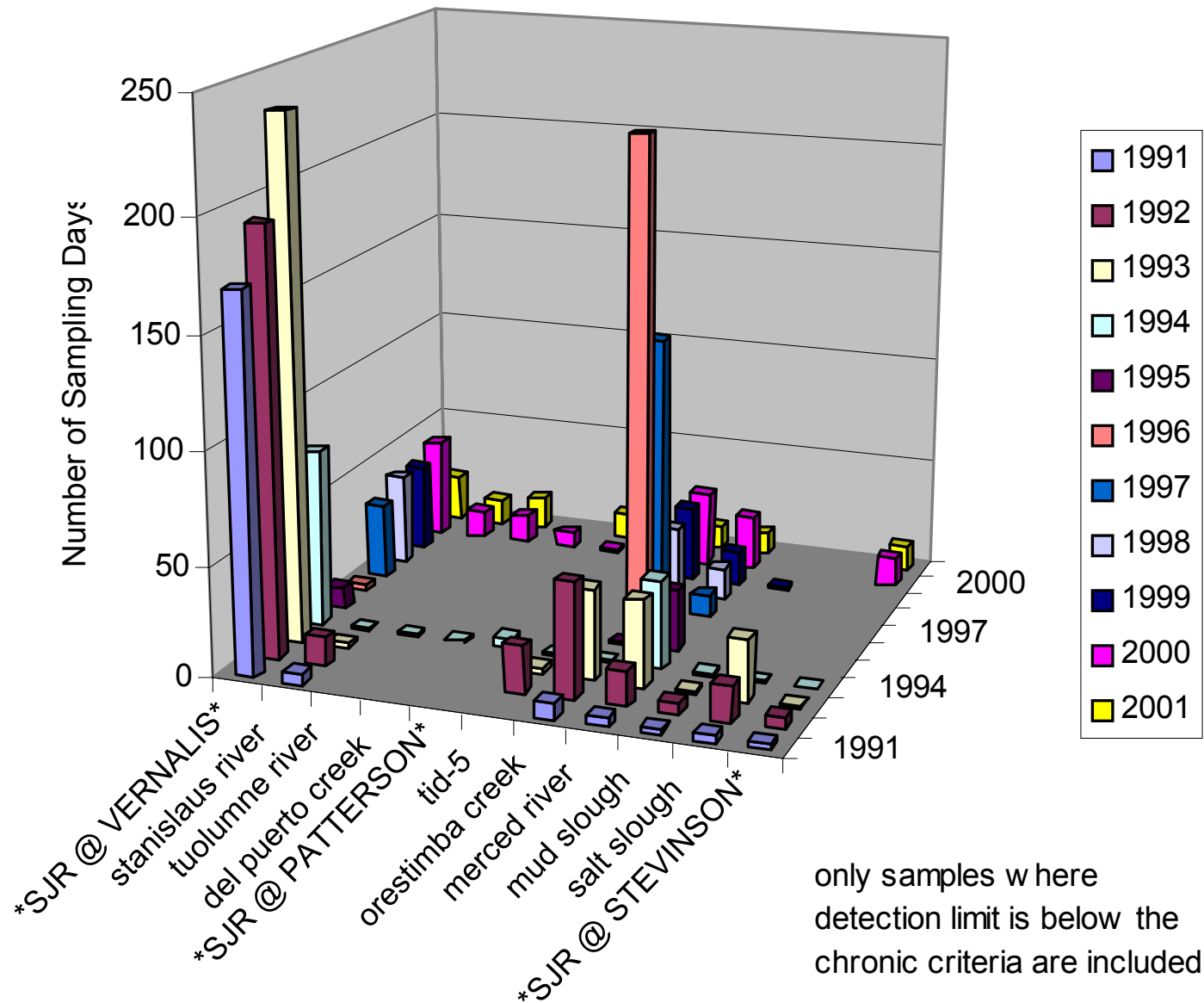
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001

only samples where
detection limit is below the
chronic criteria are included

only samples where
detection limit is below the
chronic criteria are included

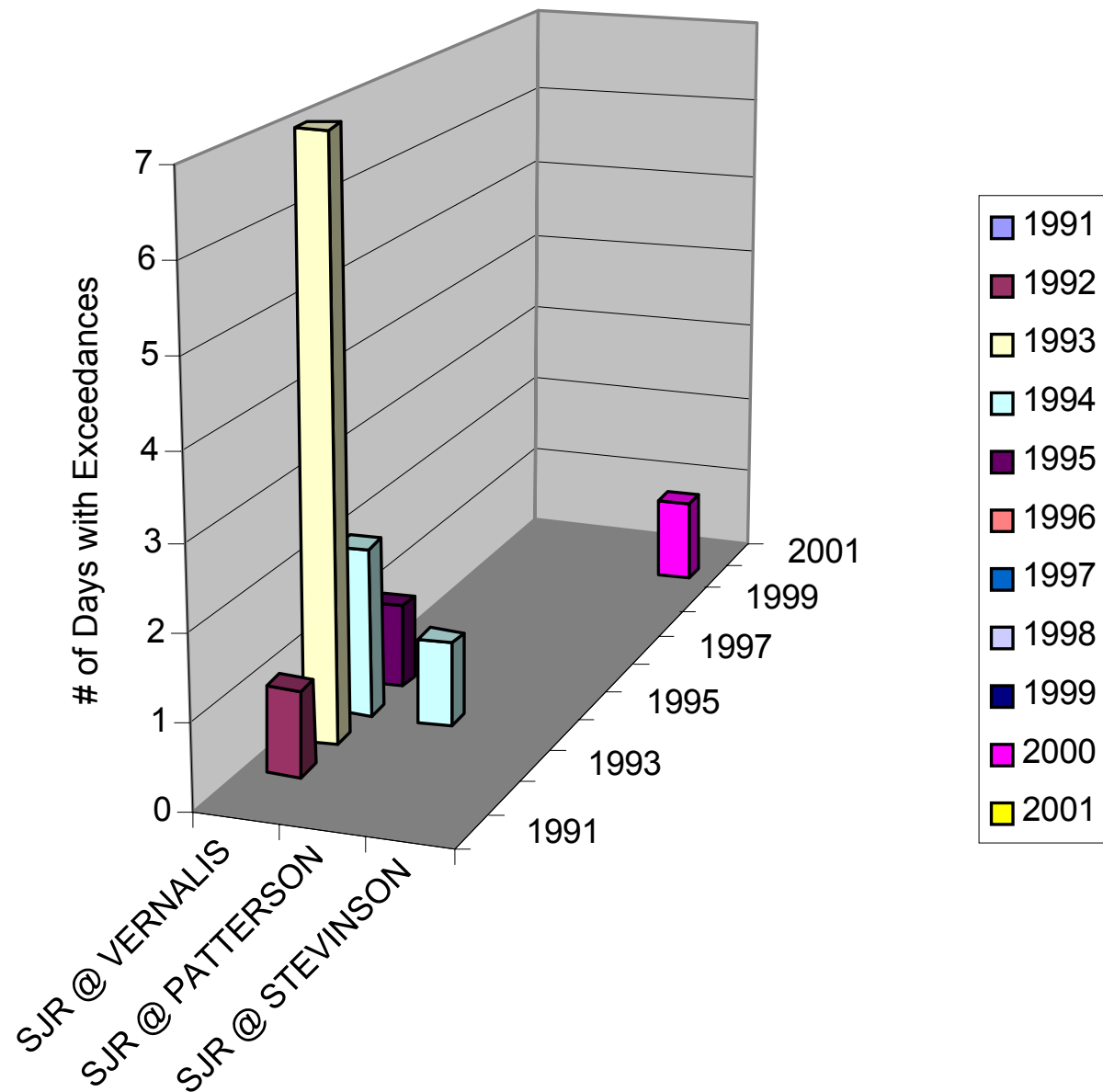
3D bar chart showing the number of days with exceedances for various water bodies from 1991 to 2001. The Y-axis represents the number of days (0-70). The X-axis lists water bodies: *SJR @ VERNALIS*, stanislaus river, tuolumne river, del puerto creek, *SJR @ PATTERSON*, orestimba creek, tid-5, merced river, mud slough, salt slough, and *SJR @ STEVINSON*. The Z-axis represents years from 1991 to 2001. The chart shows a significant peak in exceedances for the salt slough in 1996 (red bar, ~72 days) and 1997 (blue bar, ~58 days).

Number of Days Diazinon Sampled For in San Joaquin River Basin 1991-2001

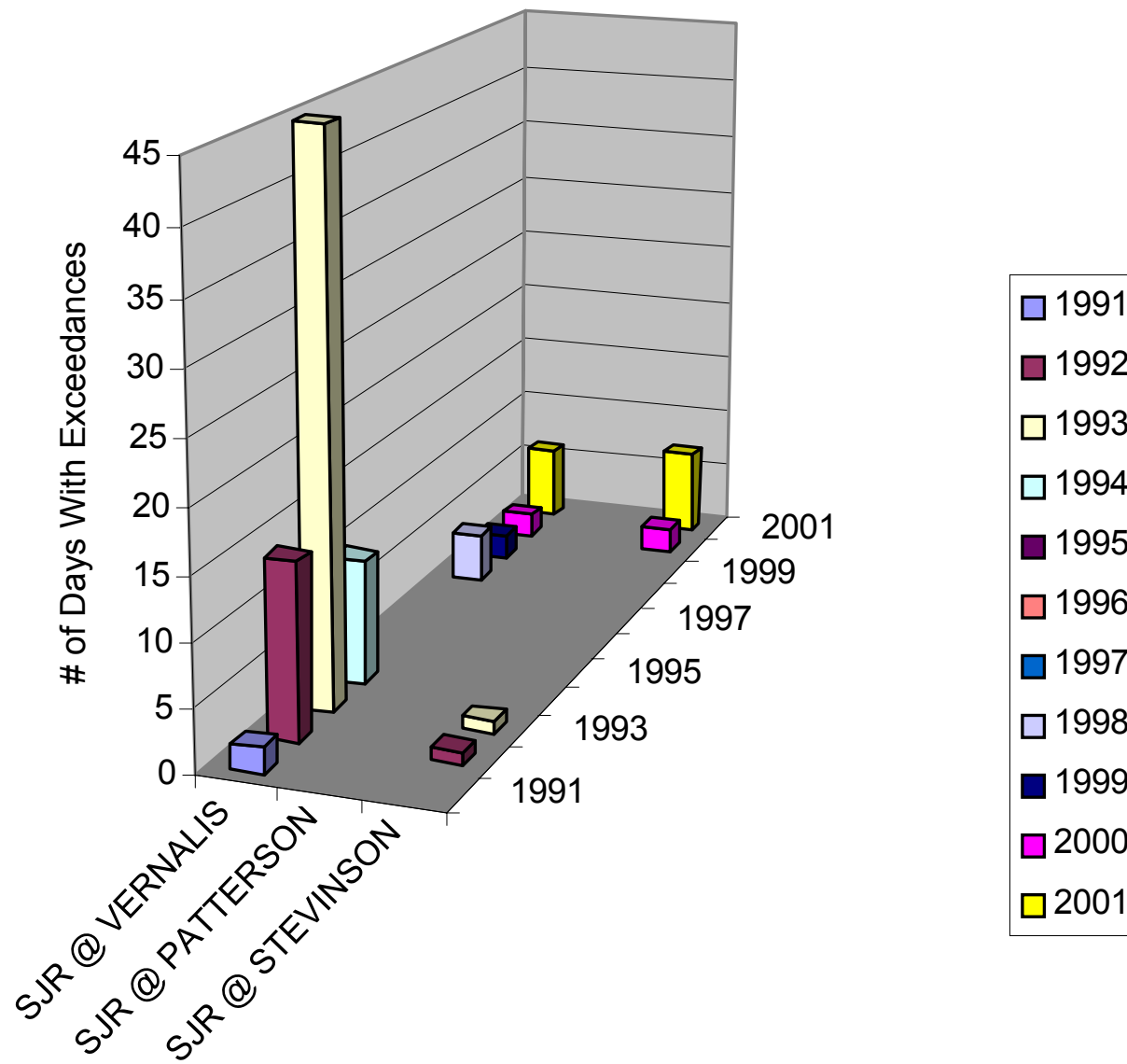


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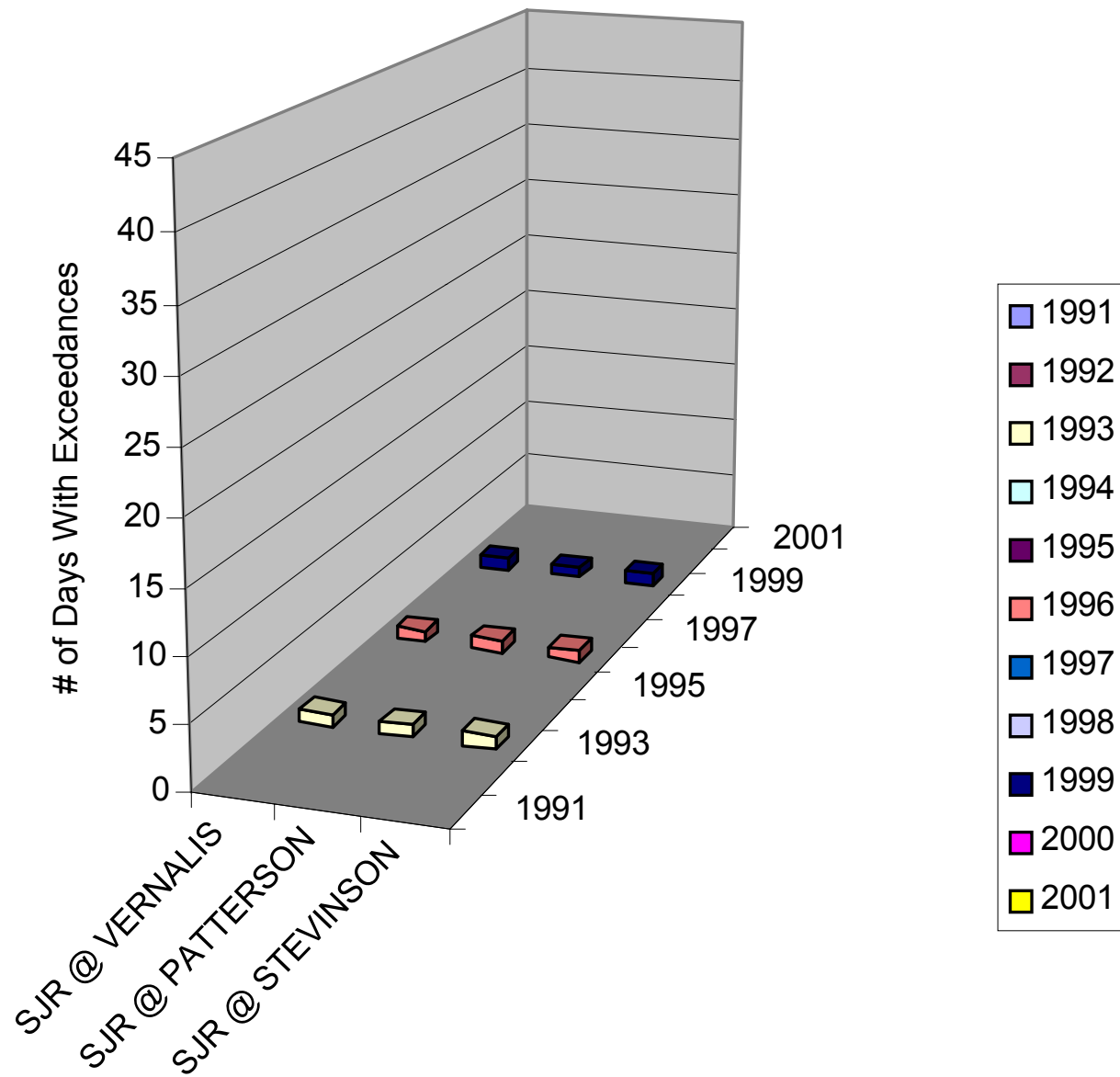
Number of Days Chlorpyrifos Observed to Exceed Acute Criteria (0.025 ug/L) in SJR Basin



Number of Days Diazinon Observed To Exceed Acute Criteria (0.08 ug/L) in SJR Basin



Number Of Acute Criteria Exceedances Allowed By EPA



Source Analysis Study

Objective:

- To identify the sources of OP pesticides so we know where reductions must occur

Approach:

- Divide the watershed into geographic sub-areas
- Use monitoring data to determine loading from sub-areas

Potential Sources of Chlorpyrifos and Diazinon

Agricultural

- *Winter Dormant Spray Storm Runoff*
- *Summer Irrigation Tailwater Runoff*

Urban

- *Urban Storm Runoff*

Atmospheric Deposition

Drift From Different Applications

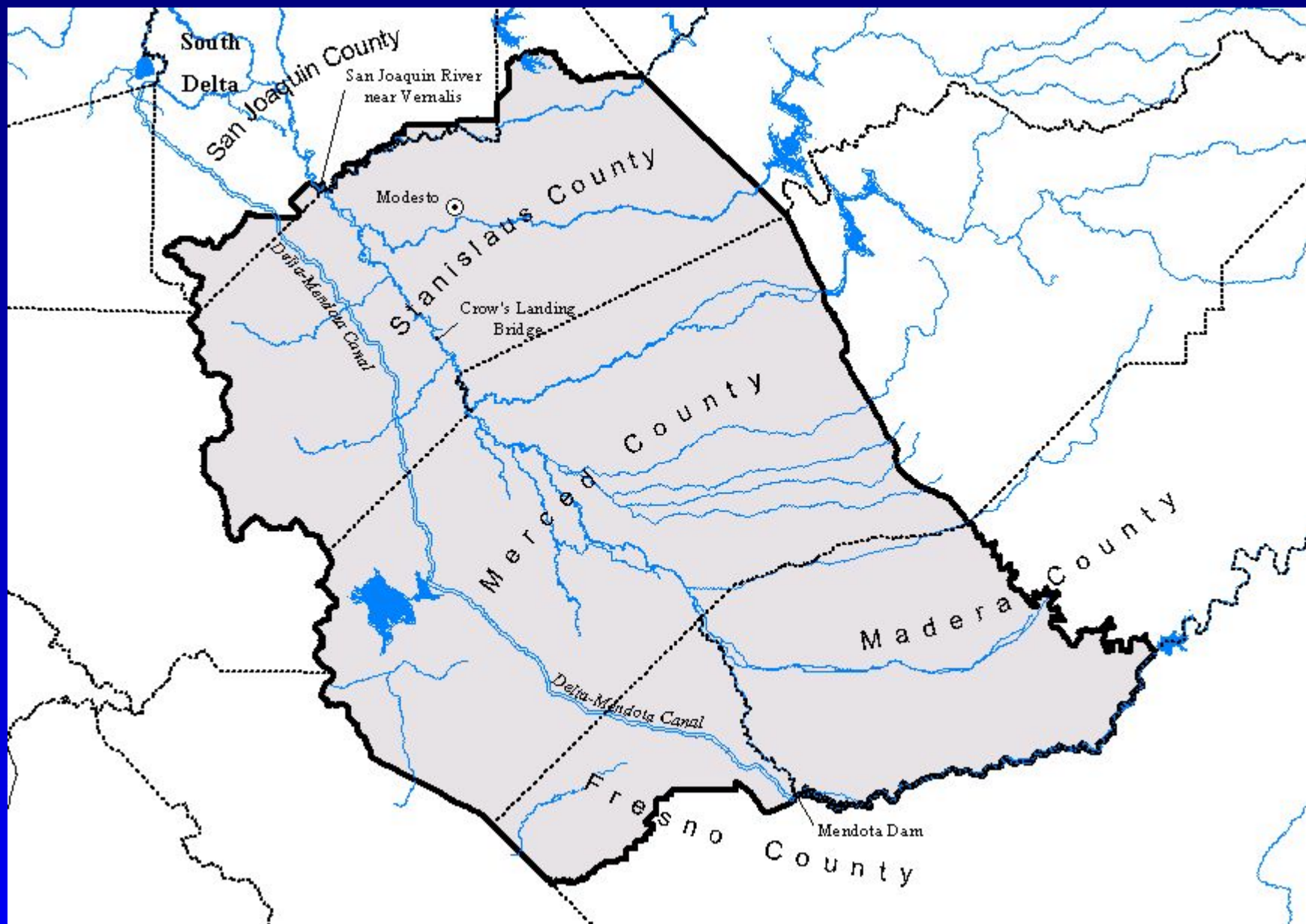
Improper Mixing and Loading Practices

Data Considered in Source Analysis

- Pesticide Use
- Flow
- Concentration

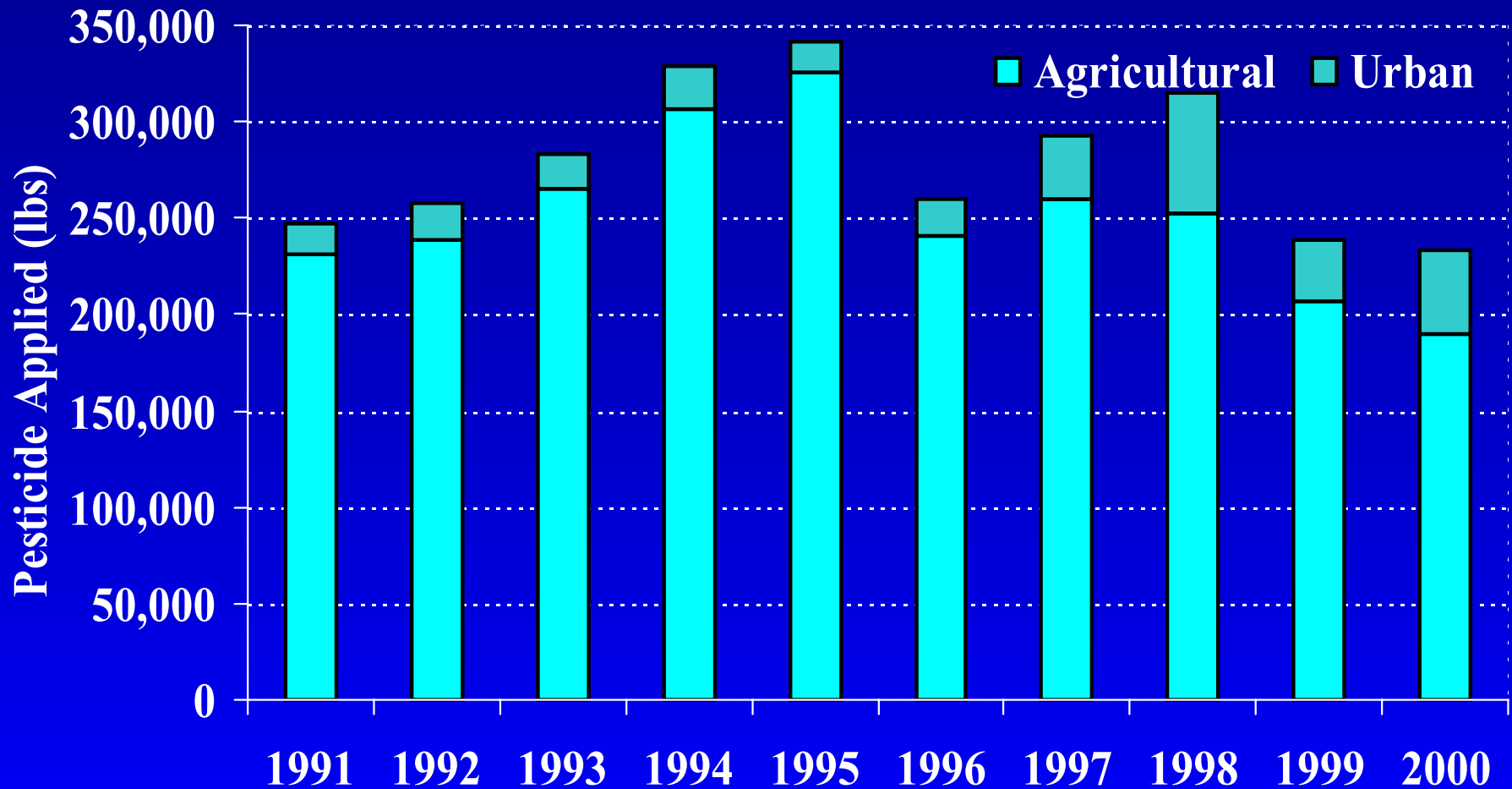
Pesticide Use

- Agricultural
- Urban
 - Structural Pest Control
 - Landscape Maintenance
 - Private Citizen (unreported)
- Unreported



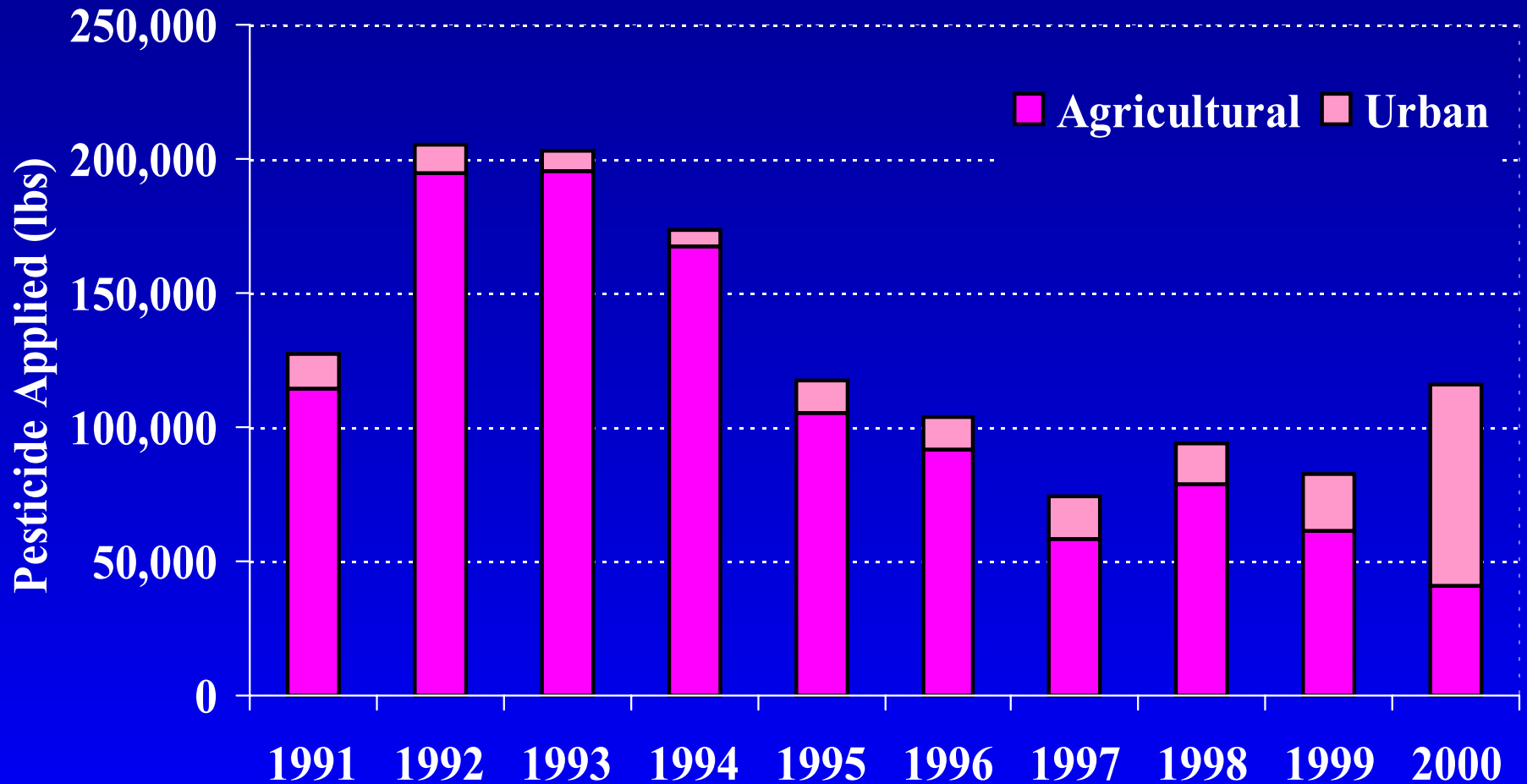
San Joaquin River Basin

Chlorpyrifos Use (PUR Reported Use)

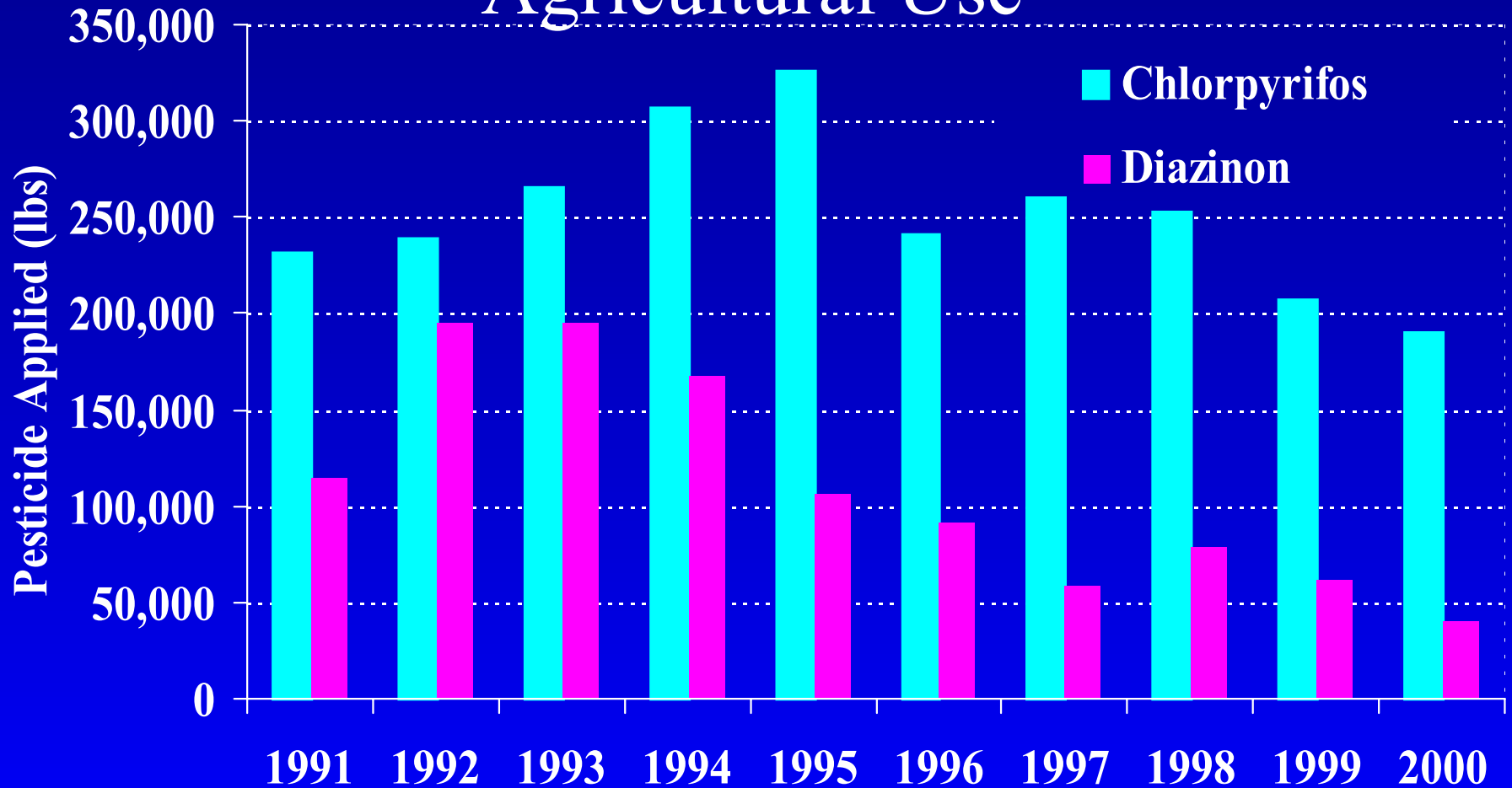


San Joaquin River Basin

Diazinon Use (PUR Reported Use)

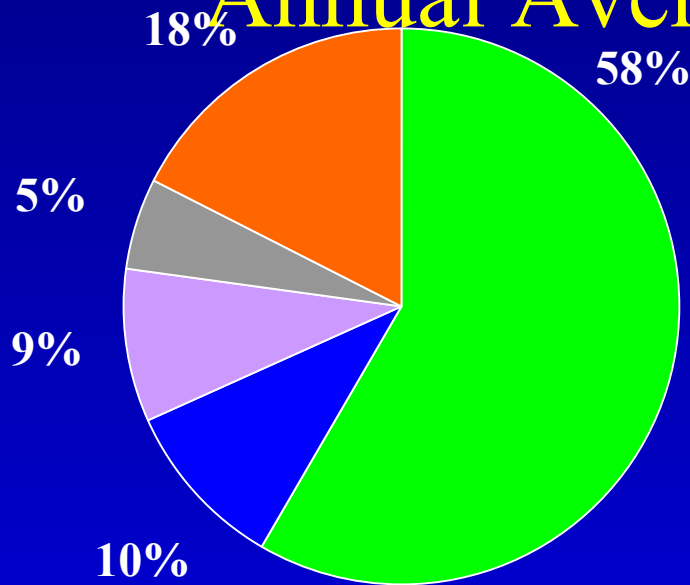


San Joaquin River Basin Chlorpyrifos and Diazinon Agricultural Use

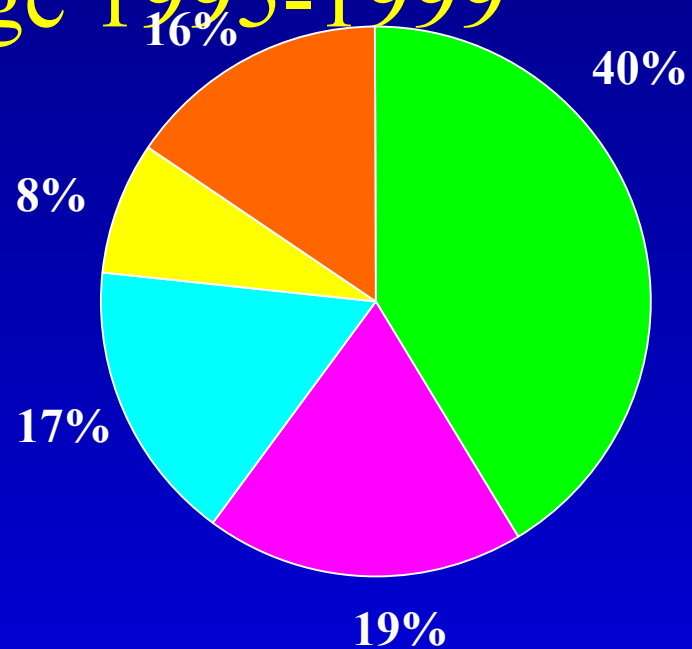


Pesticide Use* on Different Crops

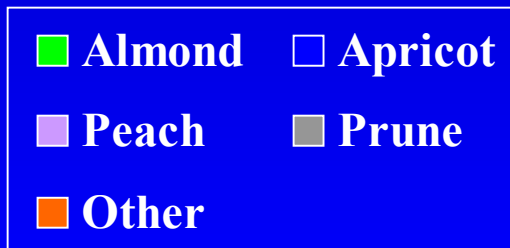
Annual Average 1995-1999



Diazinon



Chlorpyrifos



* Merced and Stanislaus counties

Replacement Pesticides

- Chlorpyrifos and Diazinon use have declined in recent years
- Market moving to other pesticides
- Potentially problematic:
 - Other organophosphorus pesticides
 - Carbamates
 - Pyrethroids
- Need to avoid creating new problems

Pesticides of Concern in the SJR Basin

Pesticide	Family	Main Use	Conc. At Vernalis 1993 (ug/L)	Conc. At Vernalis 2000 (ug/L)	Chronic Criteria for Aquatic Life (ug/L)
Chlorpyrifos	OP	almonds, walnuts	0.04	0.007-0.105	0.014 _a
Diazinon	OP	almonds	0.6	0.01-0.0947	0.05 _a
Disulfoton (Disyston)	OP	urban	N/A	N/A	0.1 _b
Dachtal	OC	truck crops	0.1	N/A	20 _b
Carbaryl	CA	peaches, vineyards	0.15	0.01-0.21	0.3 _b
Eptam	CA	corn, almonds	0.1	0.002-0.009	0.19 _b
Cyanazine	TR	cotton, corn	0.12	0.004-0.017	3 _b
Simazine	TR	almonds, vineyards	0.3	0.02-3.76	4 _b
Methidathion	OP	peaches, fruit trees	N/A	N/A	5.1 _b
Pyrethroids	Pyrethroids	peaches, fruit trees	N/A	N/A	
Bifenthrin ¹					0.02 _b ¹
Cyfluthrin ²					0.01 _b ²
Cypermethrin ³					0.43 _b ³
Cyhalothrin ⁴					0.37 _b ⁴
Esfenvalerate ⁵					0.19 _b ⁵

OP -- organophosphate; OC -- organochlorine; CA -- carbamate; TR -- triazine; UR -- uracil; AM -- amide

(a) Chronic criteria DFG study using EPA method

(b) US EPA ECOTOX Database

Pesticide Loading

- Water Column Pesticide Concentration Data
- Flow Data

Load = concentration x flow x conversion factor

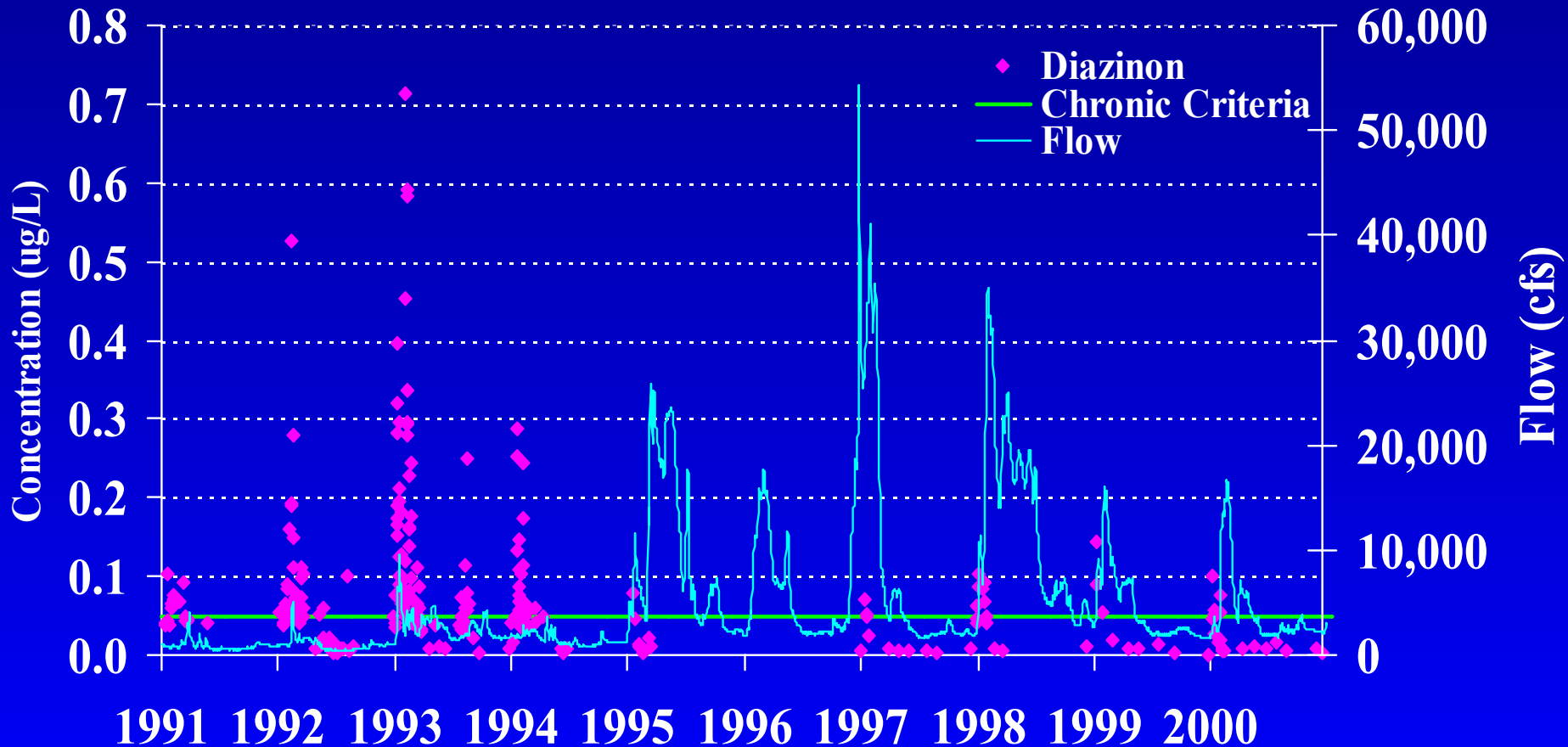
Flow data available from USGS, DWR, or direct measurement...

Pesticide concentration data available from...

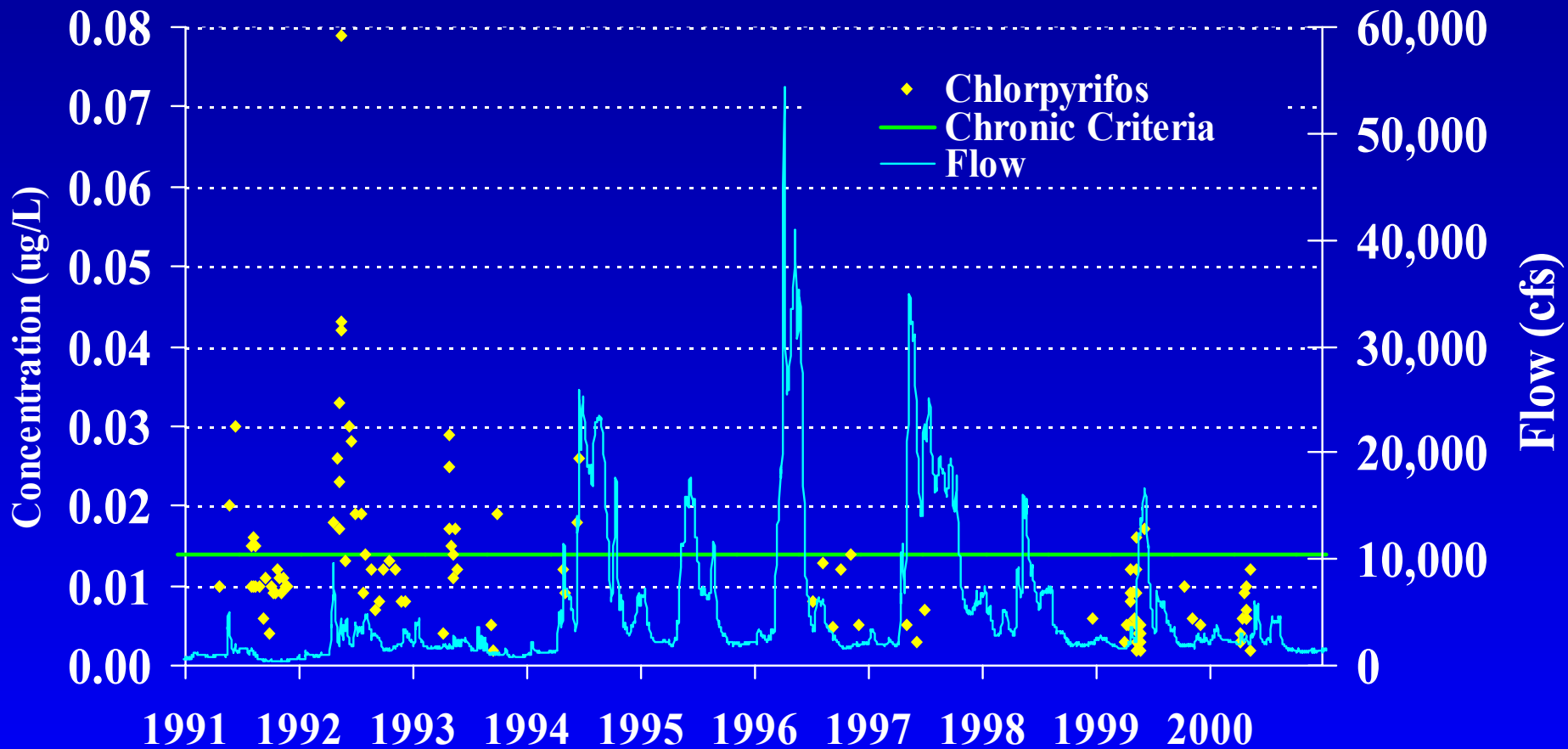
Pesticide Data Sources

- Studies by DPR, USGS, and Regional Board
- Field studies designed to characterize pesticide occurrence and source
- Since 1990, over 10 major studies in SJR Basin
- Studies collected over 3,000 samples
- Extensive long-term sampling at Vernalis (characterizes basin mass emissions)

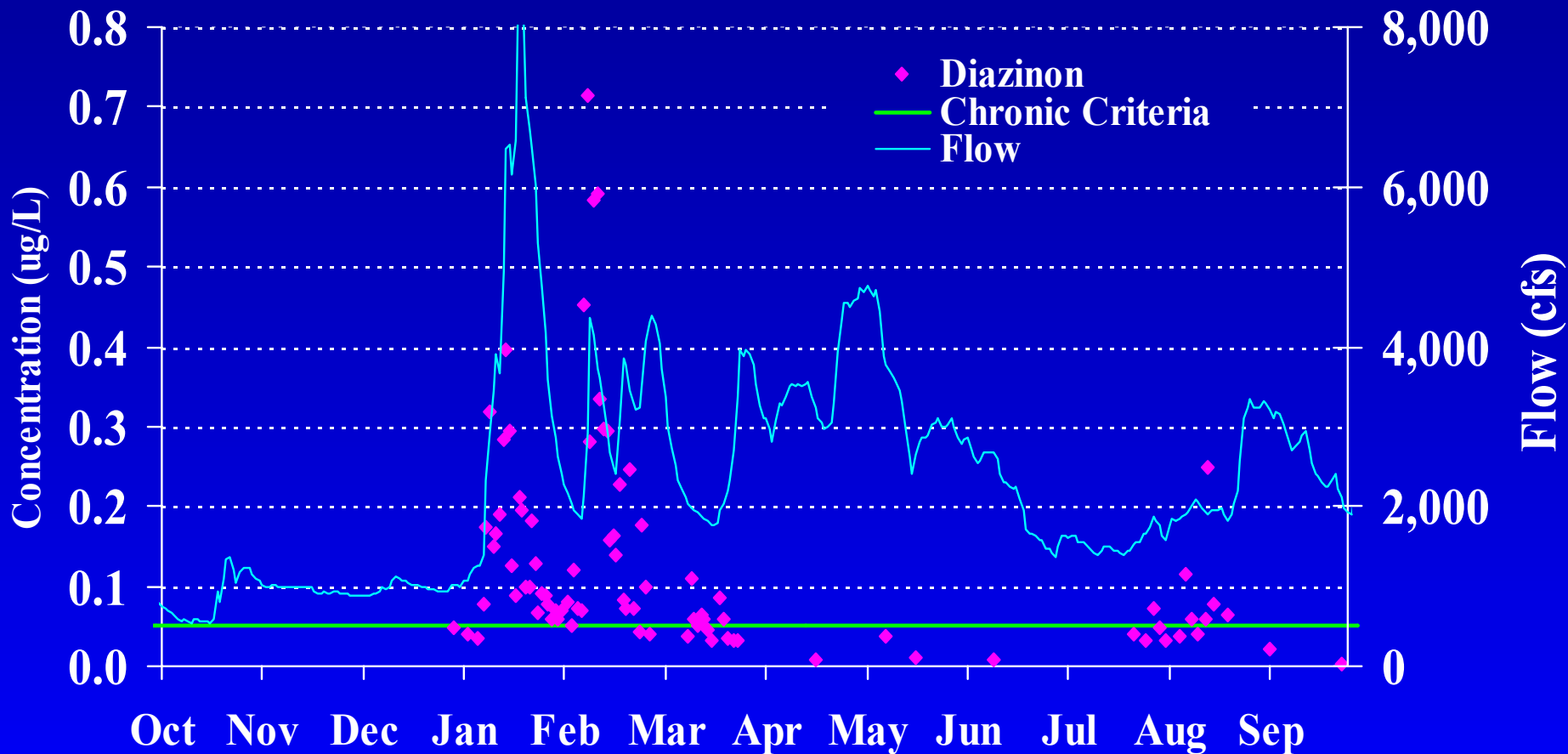
Diazinon Concentration and Daily Flow SJR near Vernalis



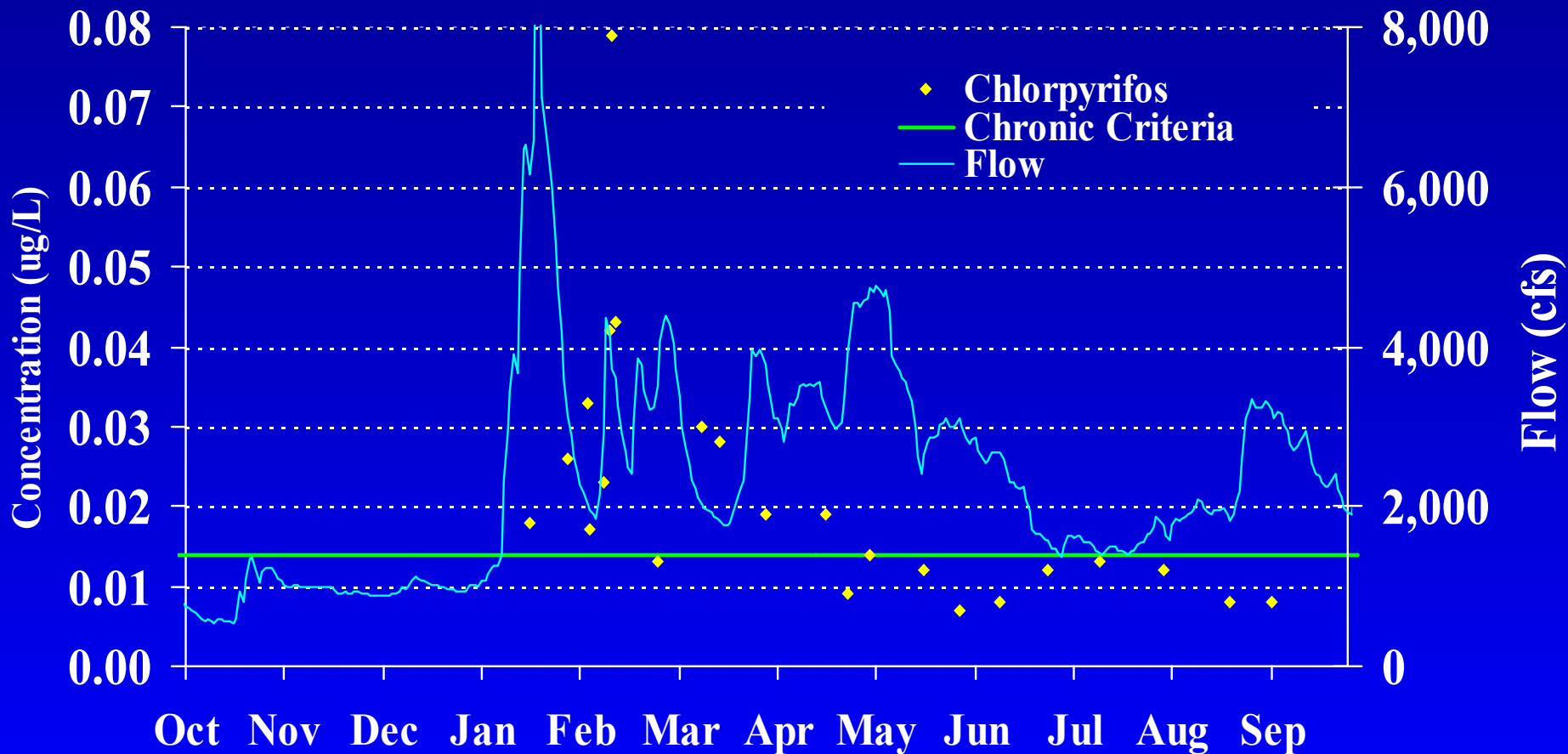
Chlorpyrifos Concentration and Daily Flow SJR near Vernalis



Diazinon Concentration and Daily Flow SJR near Vernalis Water Year 1993



Chlorpyrifos Concentration and Daily Flow SJR near Vernalis Water Year 1993



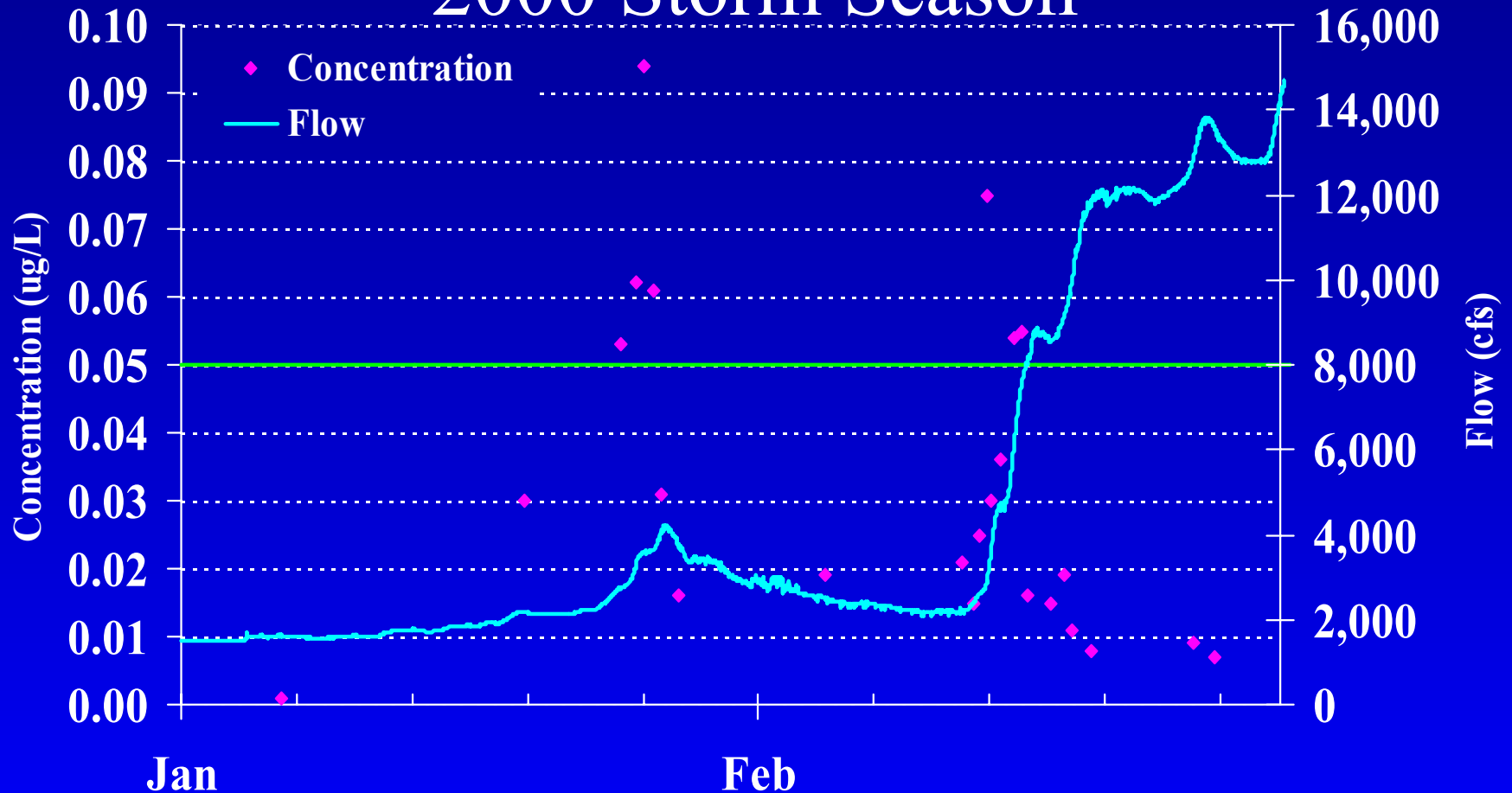
Calculating Storm Load

- Collect concentration and flow data during storm event
- Compute instantaneous loads
= concentration x flow x conversion factor
- Graph instantaneous loads
- Estimate total storm load as area beneath curve

Diazinon – SJR near Vernalis

Instantaneous Flow and Concentration

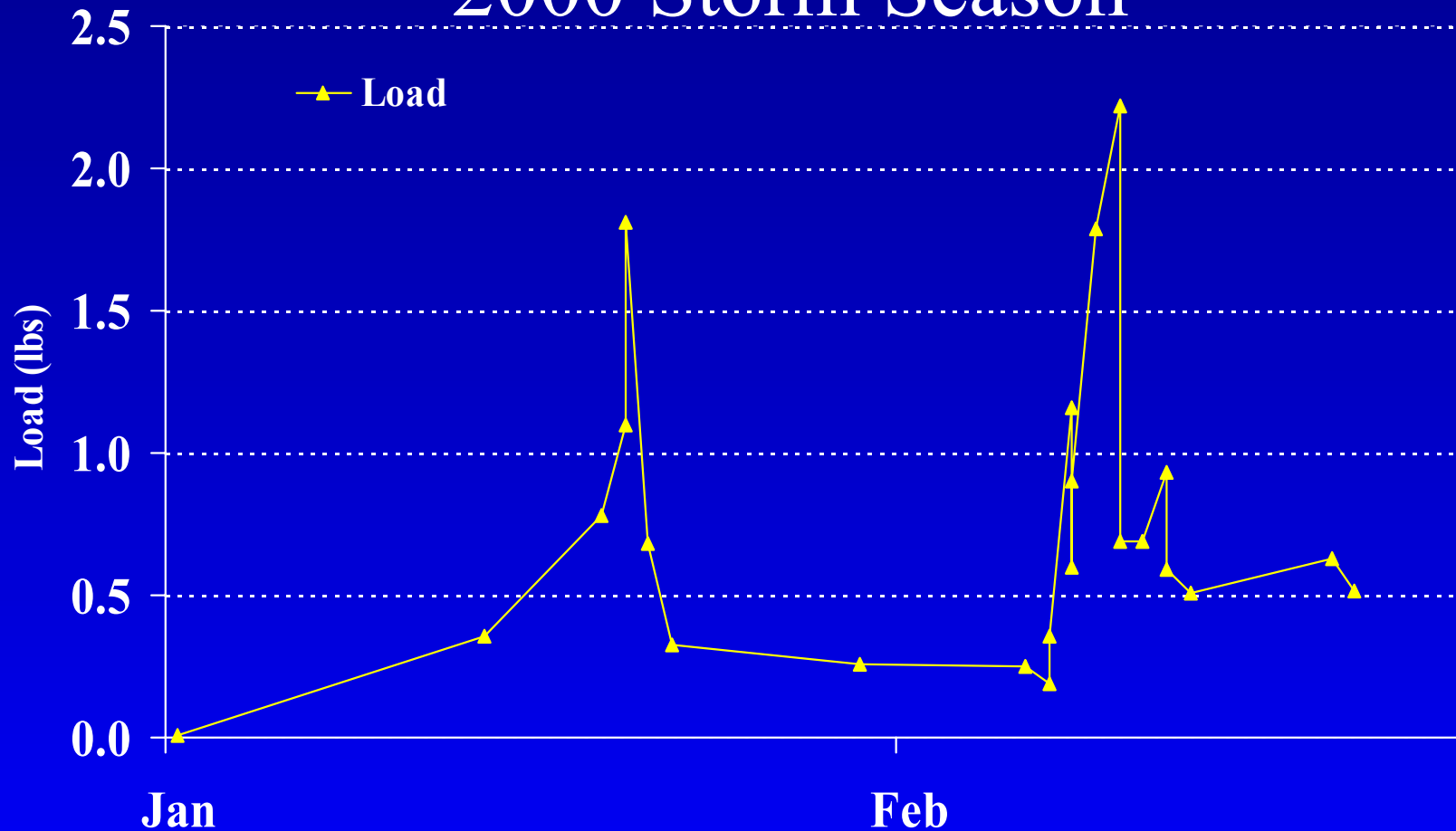
2000 Storm Season



Diazinon – SJR near Vernalis

Instantaneous Load

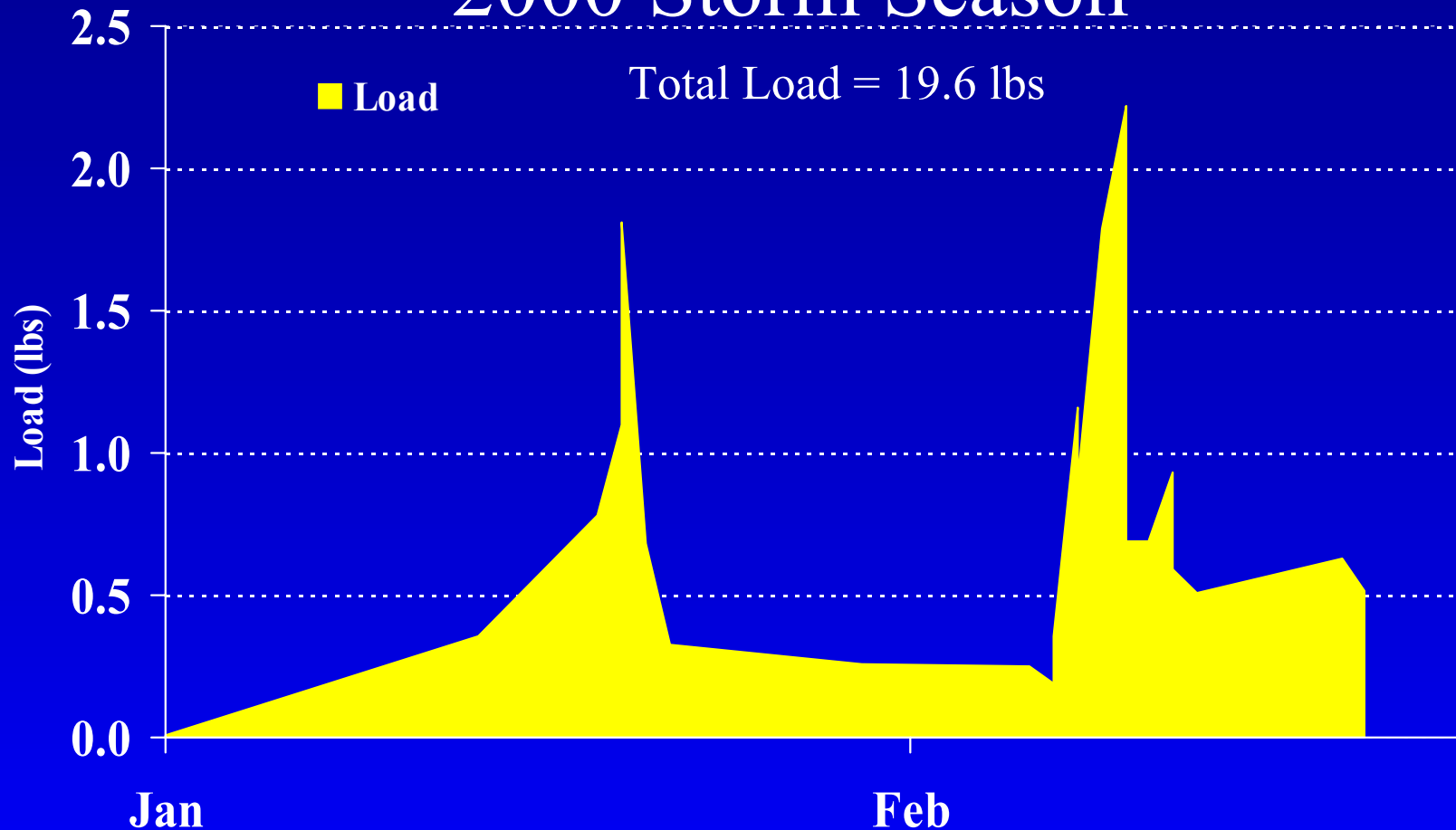
2000 Storm Season

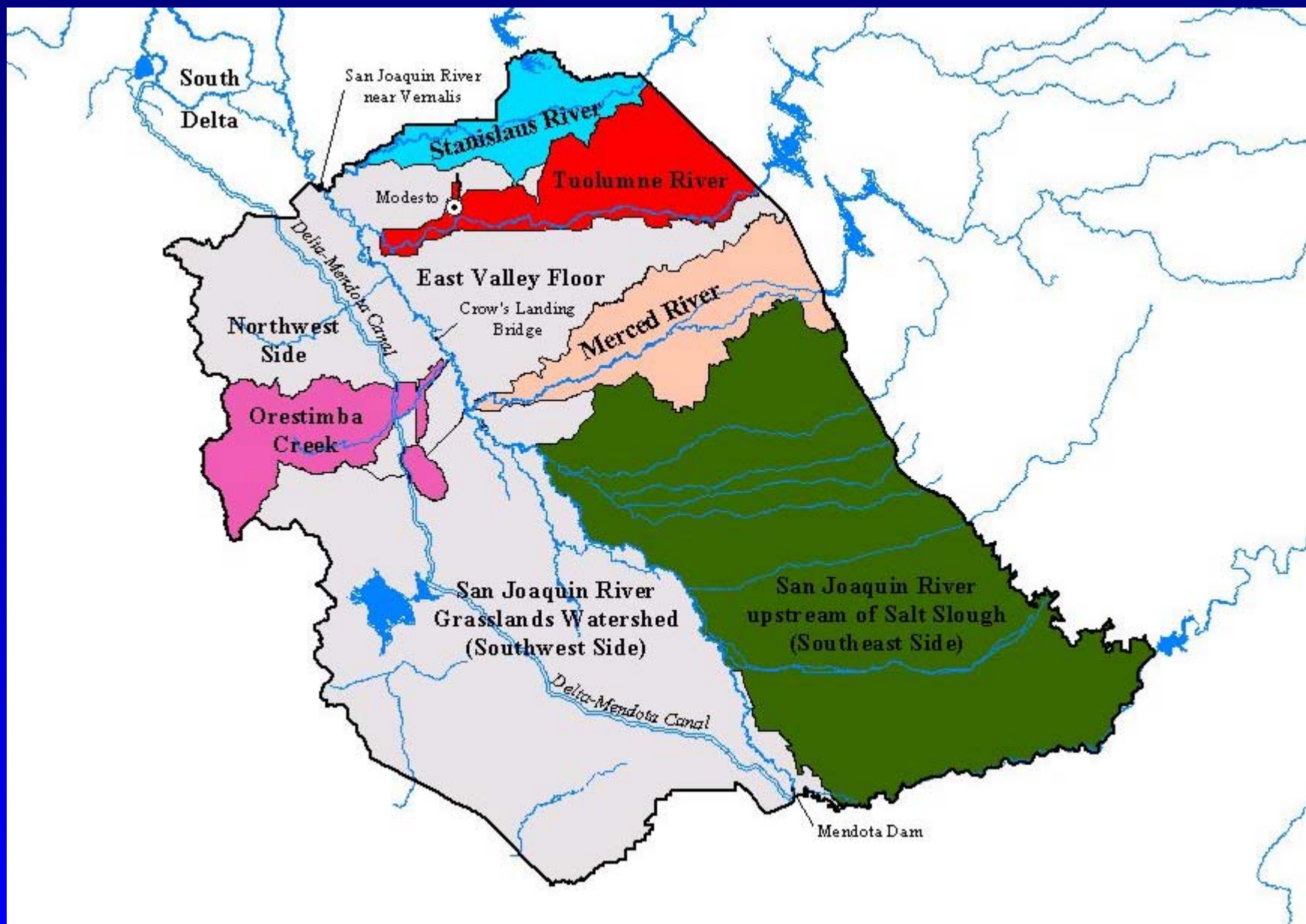


Diazinon – SJR near Vernalis

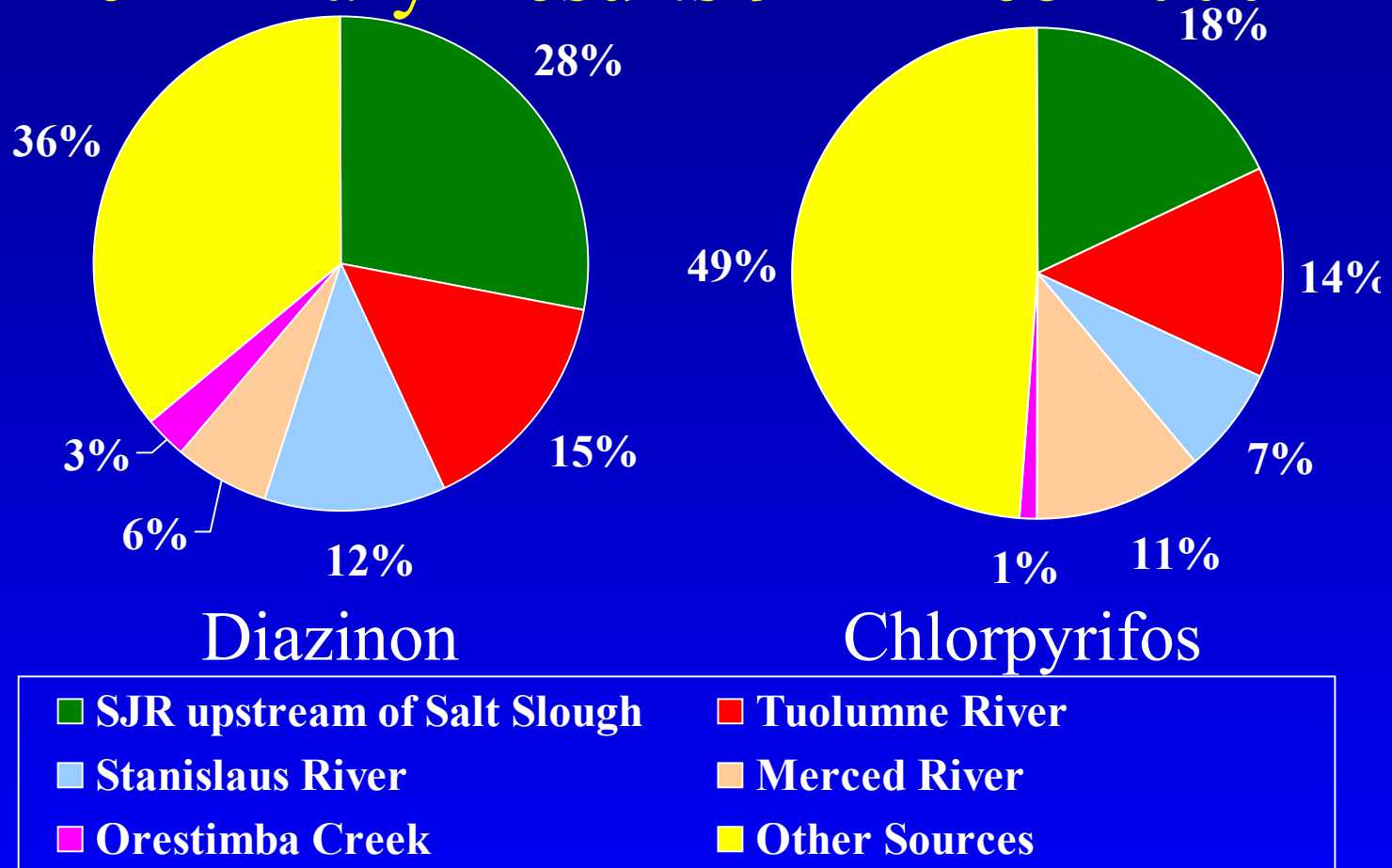
Instantaneous Load

2000 Storm Season





Comparison of Single Storm Loads From Major SJR Tributaries Preliminary Results 9-14 Feb 2000



2000 Single Storm Load at Vernalis Diazinon – 4.9 lbs Chlorpyrifos – 1.5 lbs

Dormant Spray Season Summary

- Concentrations of diazinon and chlorpyrifos frequently above criteria
- Occurrence of pesticides and frequency of exceeding WQOs are persistent over time
- Persistent spatial distribution:
each sub-area contributes to load

Dormant Spray Season Summary (continued)

- Data suggests that agriculture is primary source:
 - Association of agricultural application to observed loads
 - Sub area sources of loads
 - Consistent with conclusions reached by USGS studies

Irrigation Season Summary

- Similar methods are used to estimate loading during irrigation season
- Available data is more sparse
 - most recent year still being compiled
 - additional information will be obtained this summer

Next Steps (Technical)

- Complete Source Analysis
- Calculate Load Allocations
- Perform Linkage Analysis
- TMDL Report for Diazinon and Chlorpyrifos

Load Allocations

- Review historical flows for SJR main stem sites
- Estimate maximum load allowable to meet acute and chronic criteria with no more than one excursion every three years
- Allocate loads to sources (subarea, crop)
- Margin of Safety

Load Allocations (Considerations)

- Must consider additivity (allowable load based on sum of diazinon and chlorpyrifos)
- Base flows during irrigation season
- Storm flows during dormant spray season
- No more than one excursion (total) every three years for irrigation and dormant spray season

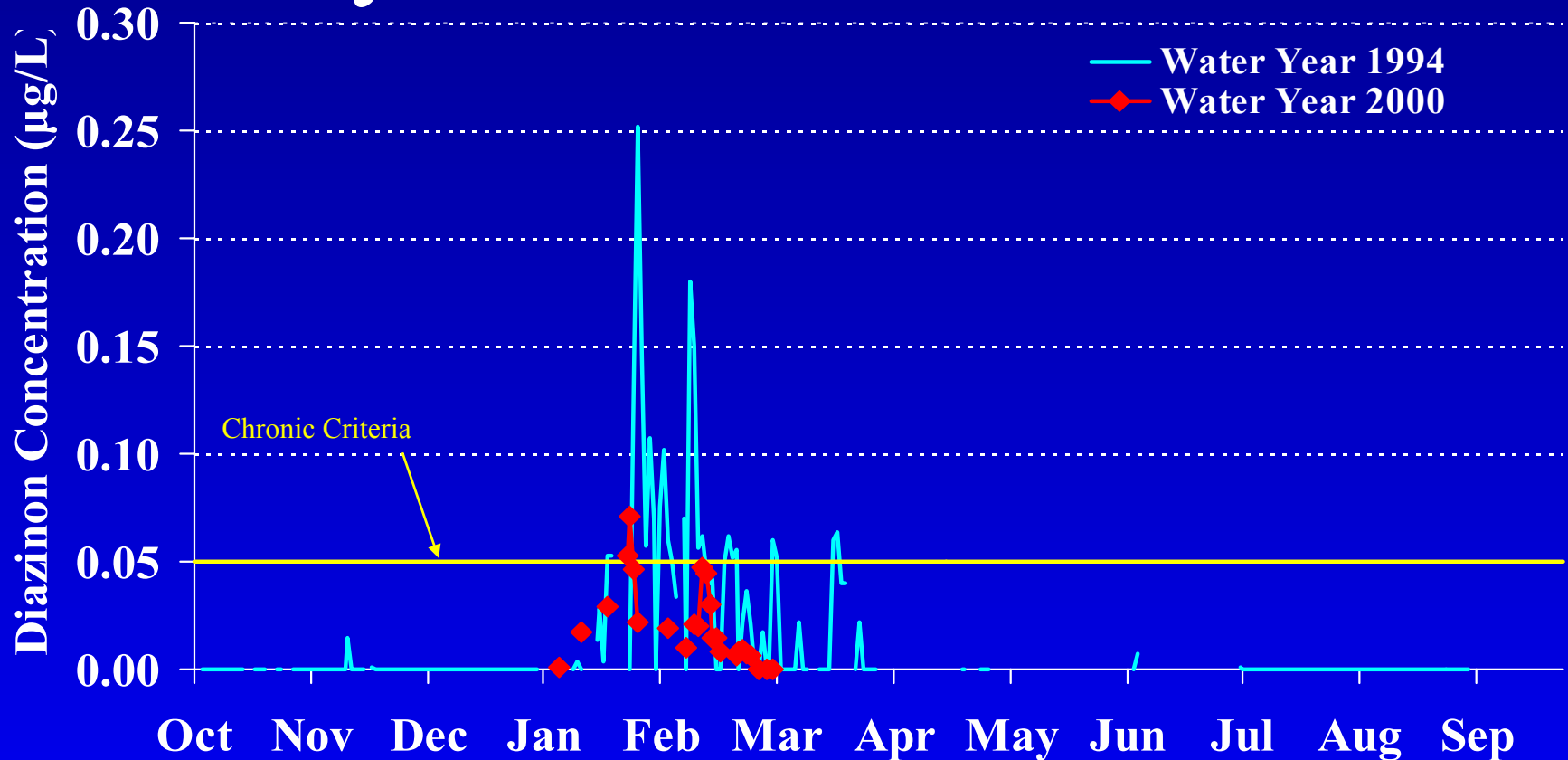
TMDL Equation

$$\text{TMDL} = (\text{Design Flow}^*) \times (\text{Numeric Target})$$

*Occurring no more than once every 3 years

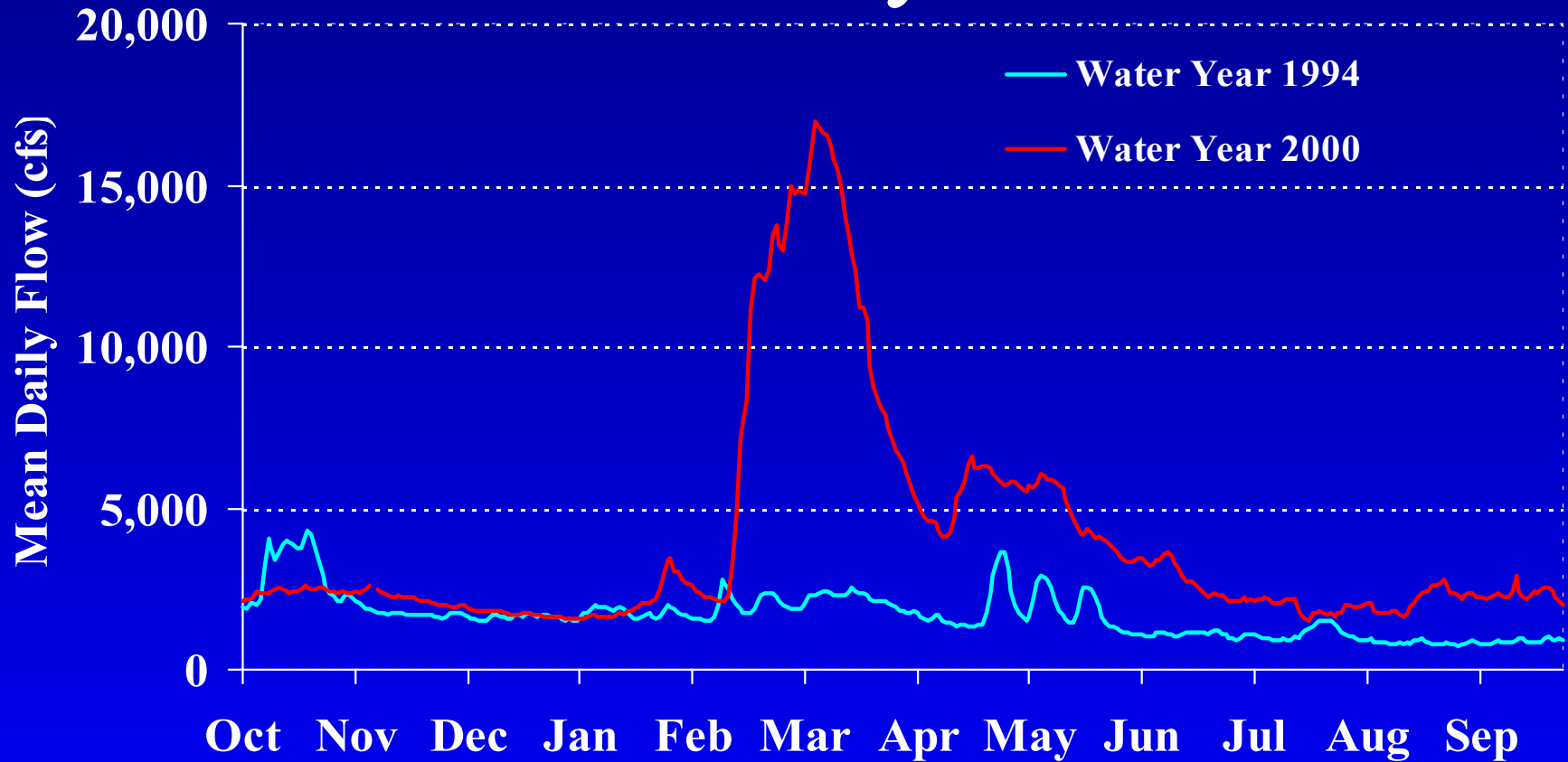
San Joaquin River Near Vernalis

Daily Diazinon Concentration



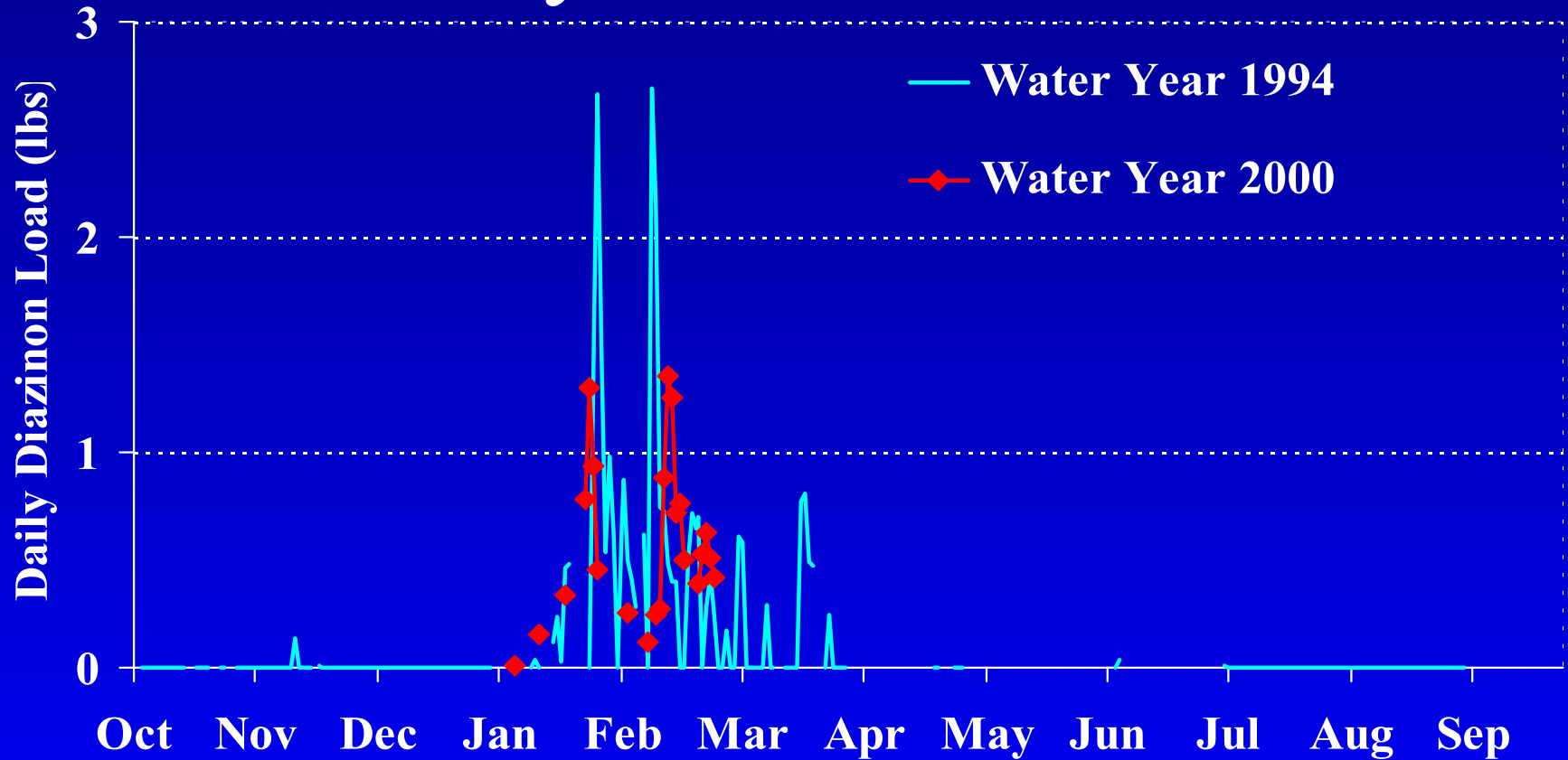
San Joaquin River Near Vernalis

Mean Daily Flow



San Joaquin River Near Vernalis

Daily Diazinon Load



Linkage Analysis

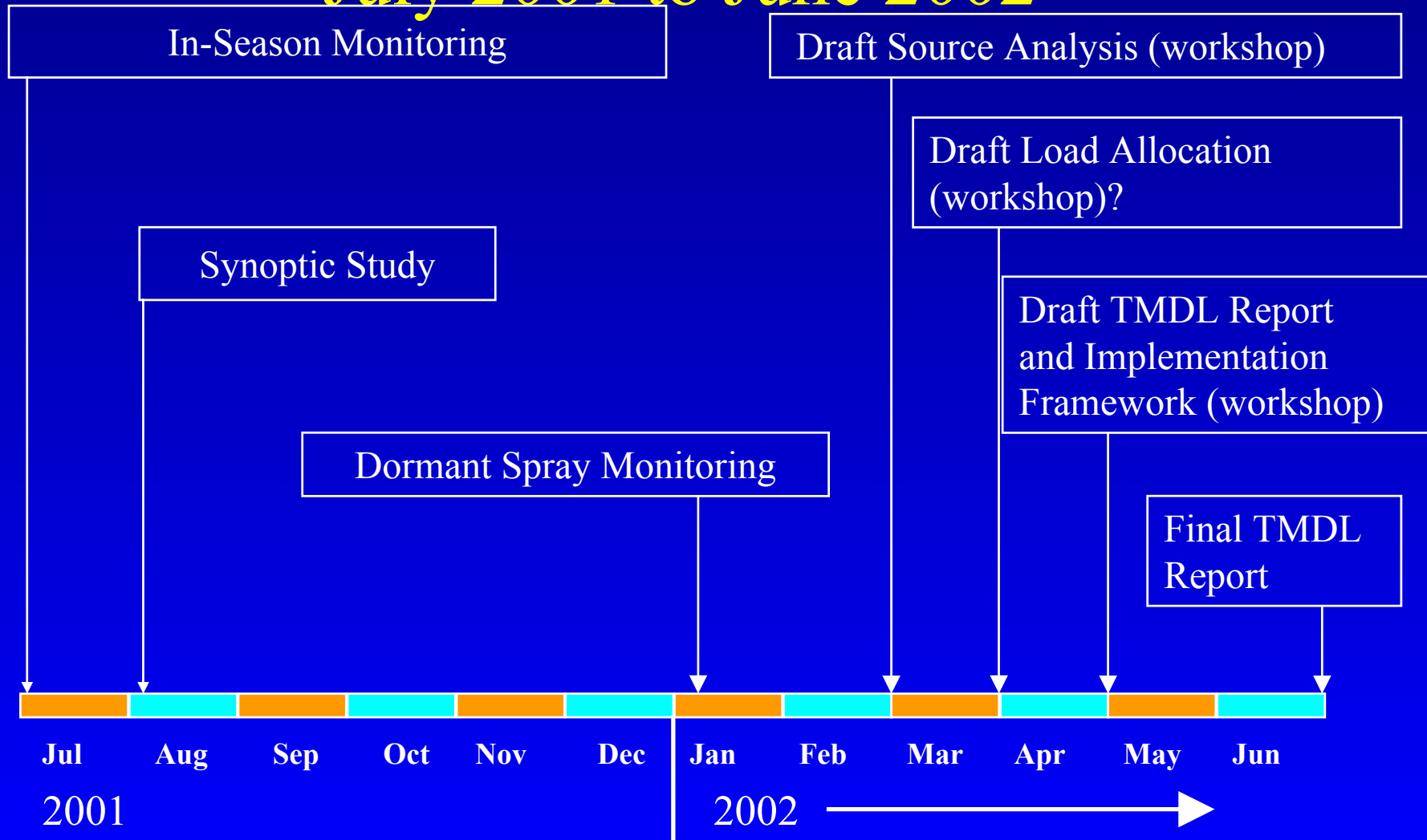
- Demonstrate the link between sources, load allocations, and attainment with water quality objectives

Next Steps (Regulatory)

- Complete Draft Basin Plan Amendment Staff Report:
 - Beneficial Uses
 - Water Quality Objectives
 - Program of Implementation
 - TMDL Elements (loading capacity, allocations, margin of safety)
 - Surveillance and Monitoring

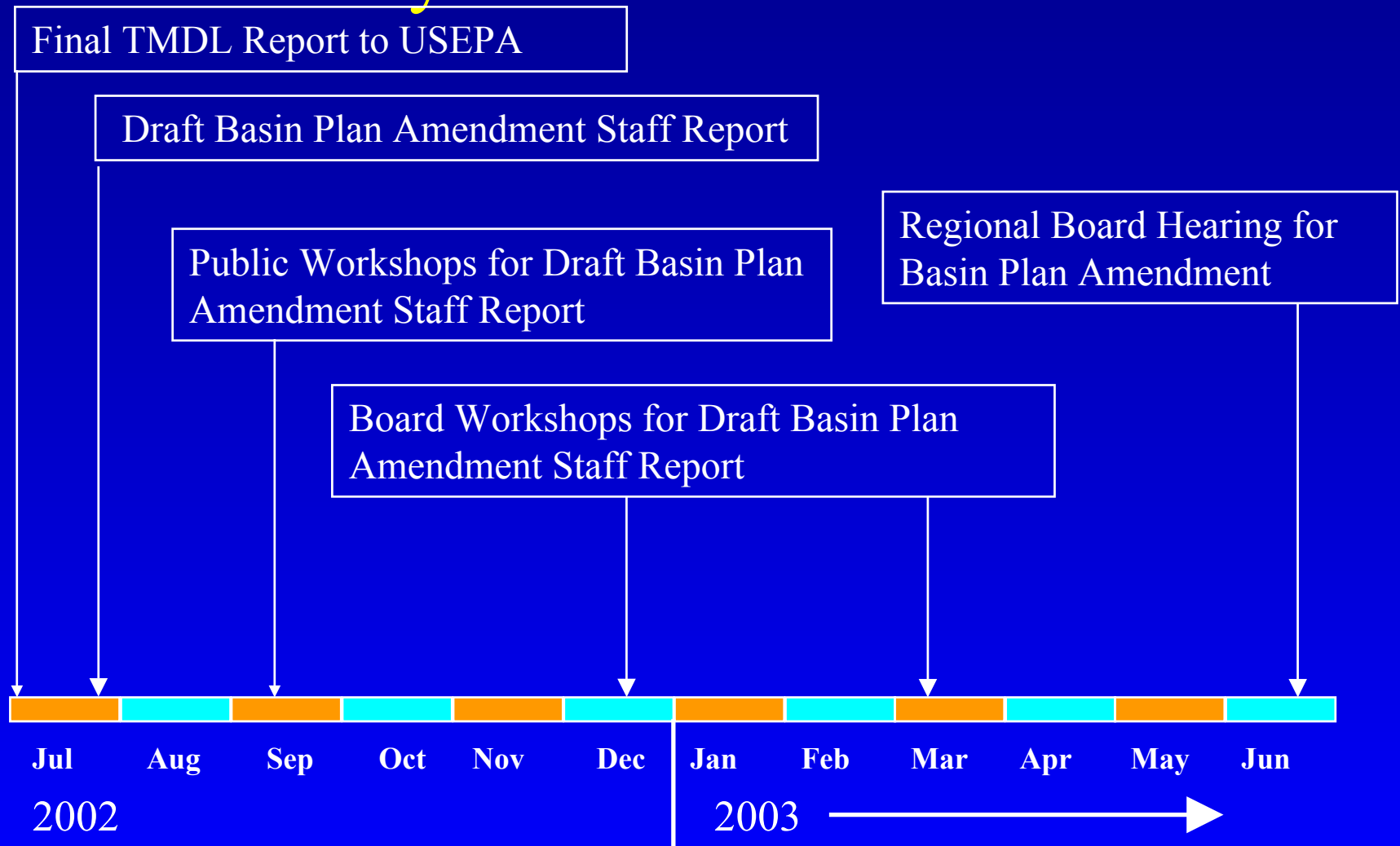
SJR OP Pesticide TMDL Timeline

July 2001 to June 2002



SJR OP Pesticide TMDL Timeline

July 2002 to June 2003



Where You Can Be Most Effective

- Provide feedback on:
 - TMDL Report
 - Draft Program of Implementation
 - Participate in Draft Basin Plan Amendment Workshops

Staff Contacts

Staff	TMDL Topic	Phone	E-mail
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